Better Homes and Gardens®

WOOD®

The Shop-Proven Woodworking Magazine

ISSUE 161 FEBRUARY/MARCH 2005

GET THE BEST HARDWOODS FOR LE$$ p.48

cut the clutter!

closet storage system p.38

TOOL BATTERY TRUTHS 12 tips for maximum life

Finishing magic—turn bargain boards into high-dollar stock

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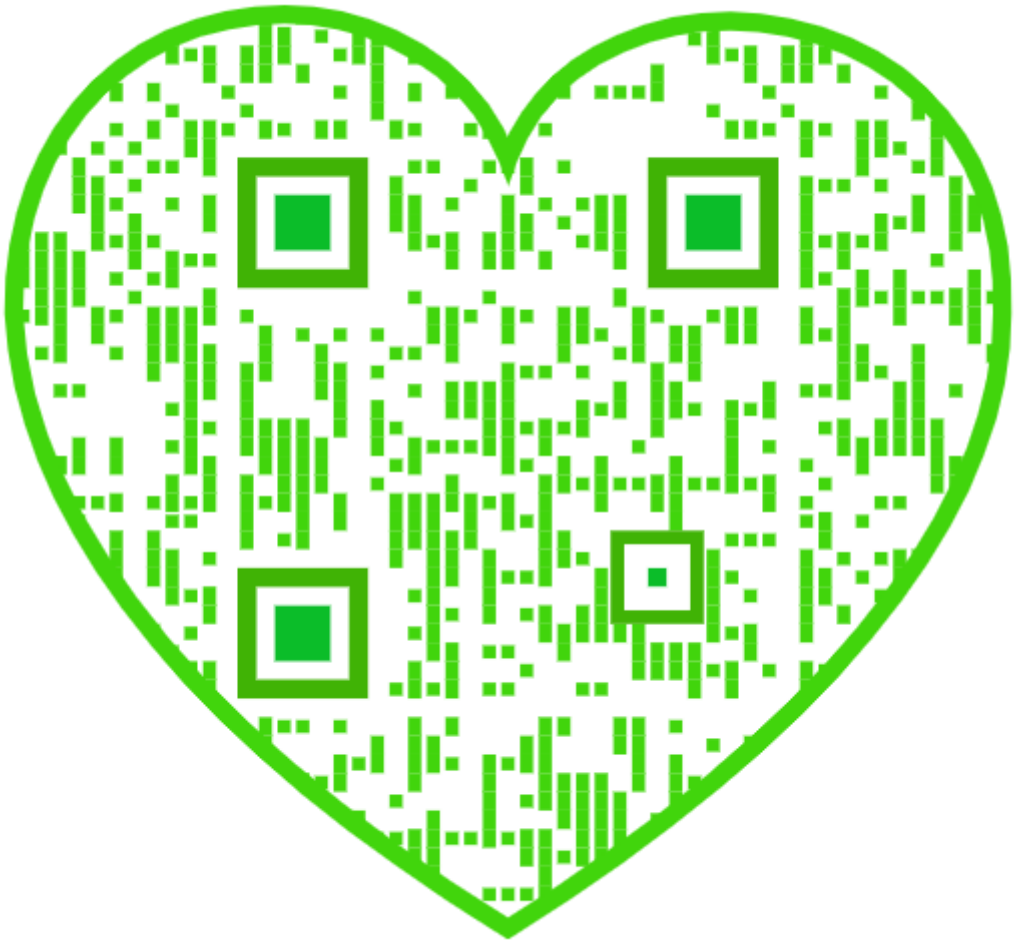

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This seal is your assurance that we build every project, verify every fact, and test every reviewed tool in our workshop to guarantee your success and complete satisfaction.

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WOOD®

February/March 2005 Vol. 22, No. 1 Issue No. 161

Owen built the planter from issue 148 for his wife.

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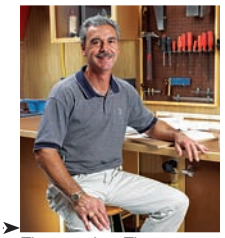

The next time The Woodworking Shows comes to town, take in Jim's demonstration.

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In Memoriam — E.T. Meredith III (1933–2003)

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a place for everything

Most of us live in homes where finding ample storage for our possessions can be a challenge. Fortunately, because of your woodworking skills, you can do something about it. Perhaps all you need are some ideas and plans to get started.

Even after 14 years, I still clearly recall the final sledge-hammer blow that brought down the garage at the end of my driveway. That circa 1925 garage/shack was small (18×18') with barely enough room for two cars. There was, of course, no space for lawnmowers, bikes, garden tools, and the countless other things that end up in garages.

But that final smack of the sledge hammer was putting me on the road to better days. Upon the spot of that ancient shack I built a huge 24×36' garage — by code it was as big as I could build without pouring footings. It had 9' ceilings and attic-style roof trusses for even more storage. One neighbor remarked that it looked like an airplane hanger. It had room to spare for everything, including two cars and my woodworking shop. I felt like my storage problems were solved forever.

Fast-forward to 2005 and that garage is bursting at the seams. Three children have come along and added all of their toys. I've acquired a stationary planer, a canoe, snow blower, power washer, countless garden implements, and lots of lumber. We no longer have room to park cars in that garage.

My point: Like many of you, I have as much space as I'll ever have. Adding more isn't an option right now. The only solution is to make better use of the space we do have. It's time to get organized.

Help is on the way

To lend you a hand, in this issue we're kicking off a two-part series featuring projects for organizing the areas of your home that need it the most. On *page 38* you'll find a modular closet storage system. In the next issue, you'll find a terrific shop-made system for getting your garage and basement in order.

Before designing these systems, we set a few goals. First, they have to be versatile and modular to meet your requirements. Whether you have a single-door closet, one with bifold doors, or a walk-through room, the closet system will fit your space and hold all of your clothes, shoes, and other items. The garage/basement storage system will be equally adaptable to your needs.

Another priority was to design something that's easy to build. The closet system consists of three basic boxes, all built the same way, using just your tablesaw to fabricate the parts. Each box can be customized with simple-to-add doors, drawers, or shelves. Except for a few special screws, you can find all of the necessary materials at home centers. The system works in conjunction with existing closet wire shelving, bins, hooks, and clothing poles found everywhere.

I can't guarantee that your storage problems will be solved forever, but these systems are a big step in the right direction. And your spouse will love the results!

Bill Krier

sounding board

Our bulletin board for letters, comments, and timely updates

From a pile of scrap to beautiful gifts

With the holidays approaching, my wife and I decided to give architectural shelf clocks (December 2003, issue153, page 105) as Christmas gifts. As shown *right*, I used contrasting woods from my shop scraps. I drilled a hole in the back so you can pop out the clock movement for setting the time and changing the battery.

Bob Smith, Lakebay, Wash.

Photograph: Bob Smith

Article updates

September 2004, issue 157

The bottom half of Step 1 under "Build the base, top, and shelves" on pages 50 should read: "...outside corner of each foot. Adjust your biscuit joiner to cut slots for #0 biscuits in the legs where shown on the patterns and Drawings 8 and 8a. Then adjust the biscuit joiner to center the slots in the ¾" thickness of the rails and cut slots where shown on Drawing 8." See drawing at *right.*

Note the same label change for TV stand drawings 3 and 3a (page 57), and for end table drawing 3a (page 68). Change the labels indicated for the tower case drawing 1 (page 49) and door tenon details drawing 10 (page 52) shown at *far right.*

The last sentence of Step 1, page 52 should read: "Then raise the blade to 1⅝", and cut a groove in the upper rail."

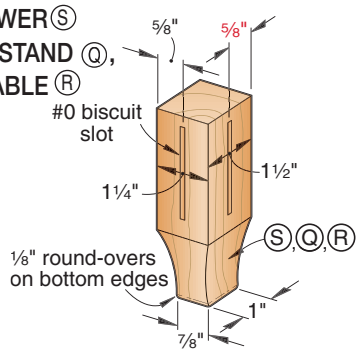
November 2004, issue 159:

• The model for the MLCS cast-iron router table on page 89 should read #9593.

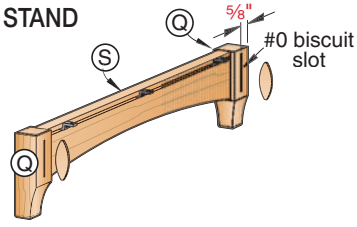
• "Vertical Stock Pushstick" drawing, page 80, change label to 30° bevel on handle.

• The plunge base of the Porter-Cable plunge router #895PK, discussed on page 70, does come standard with dust collection. On page 72 under "Low points," the first point should read "The auto-engaging spindle lock doesn't work with the optional dust shroud...." Note, however, that the spindle lock can be operated manually.

8a TOWER Ⓢ
3a TV STAND Ⓠ, END TABLE Ⓡ

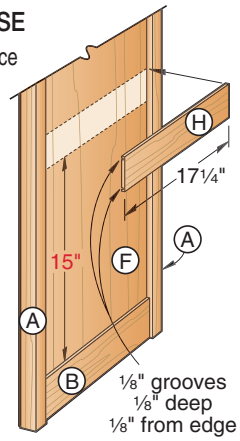


3 TV STAND



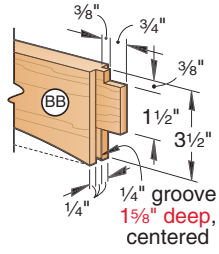
1 TOWER CASE

Note: Change distance from Ⓑ to Ⓗ on side panel Ⓕ to 15" from 18".



10 DOOR TENON DETAILS

Note: Change depth of groove to 1⅝" from 1⅛".



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■ **Updates to previously published projects:**
For an up-to-date listing of changes in dimensions and buying-guide sources from issue 1 through today, go to woodmagazine.com/editorial.

Classic oval table becomes a big star

My son-in-law, Aaron Crabb, who lives in Shenandoah, Iowa, used one of your designs (the "Classic Oval Table" from the February 2001 issue 130) as inspiration for a wedding present he made for his best friend.

Lisa Shaeffer, Des Moines, Iowa

In speaking to Aaron, an engineer with Pella Windows, we learned more about the table. Unlike the solid walnut top in the original design, Aaron used medium-density fiberboard (MDF) and covered it with a 12-way-radial walnut veneer pattern on the top and bottom face. He also veneered the edge. "Doing it this way avoids any problem with warpage," says the craftsman.

Though it appears to be a different wood, the six-pointed star on the top resulted from Aaron's careful use of the walnut veneer's sapwood edges. To create the three-braided inlaid border, Aaron says, "I cut out 74 individual pieces of maple veneer, then shaded them by laying them in hot sand heated in a pan on the stove." This gives the braided strands a look of graduated depth.

Photograph: Aaron Crabb

Inlay expert Aaron Crabb embellished a *WOOD*® magazine design, *inset*, by applying a 12-way radial pattern and six-point star, *above*, from quarter-cut walnut veneer and matching the heart and sapwood. The braided border is maple.

banishing burned rip cuts

Whether cutting hard maple or a dense exotic, sidestep scorching the wood by making these adjusments to your saw.

Burned rip cuts like those *above* are a warning sign of a tablesaw problem that demands prompt attention. If you ignore the problem, it will get worse. Beyond that you'll ruin lumber, waste time, stress your blade, overwork your tablesaw's motor, and even risk injury.

Possible causes may point in any number of directions, including a misaligned blade, rip fence, or splitter. Or maybe the blade is dull or caked with pitch. Your feeding technique may suffer, or the lumber itself could be the culprit. With so many possibilities, follow our step-by-step guide aimed at quick diagnosis and treatment. You'll have your machine purring properly in a jiffy.

Step 1: Inspect the blade

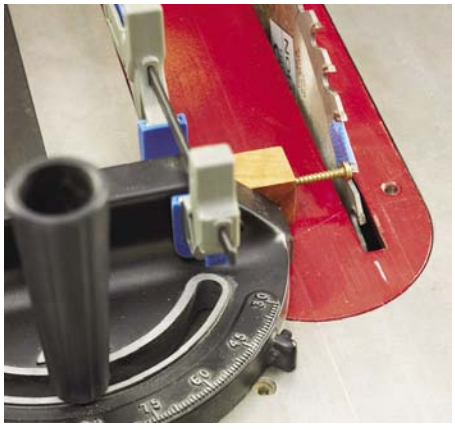
Unplug the saw, remove the blade, and inspect it for chipped carbide teeth and pitch buildup. Although a saw shop can repair chipped teeth, you may find it more cost effective to replace the blade. A dirty blade is a less expensive problem, cured with a product made just for blades. We tested them in issue 158, and Empire Blade Saver came out on top (call 866/700-5823, or visit empiremfg.com). Boeshield's Blade & Bit Resin Gum & Pitch Remover, *below*, also did well (call 800/962-1732, or boeshield.com).

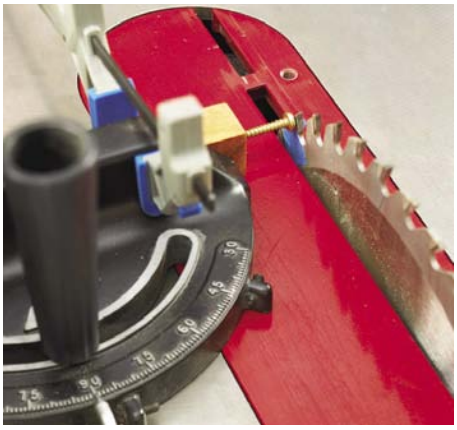
Working with a sharp saw blade, remove pitch buildup using a dedicated cleaner.

Step 2: Align the blade and miter-gauge slot

After cleaning, dry the blade and re-install it. Make sure that its rim runs parallel to the tablesaw's miter-gauge slot. The set-up shown in the photo *below* may look low-tech, but it delivers all the precision you need for this step.

Unplug your saw, and then partially drive a roundhead brass screw into the end of a piece of scrapwood. Clamp the wood to your miter gauge so the tip of the head lightly touches the side of one tooth. (Ensure that the miter gauge is set at 90º at this point.) Identify this tooth with a permanent marker or masking tape on the blade. Rotate the blade backward by hand, and slide the miter gauge until the screwhead again touches the edge of the same tooth. Ideally, the screw should touch the tooth with the same amount of pressure in both positions. (You can gauge that pressure by the slight "tick" sound that the tooth makes as you slowly rotate it past the screw head.) If not, you'll need to tweak the alignment of the blade to the miter gauge. If problems persist, adjust the saw table to the miter gauge slot.





Check for equal contact against the brass screw at both the front (as shown at left) and rear positions (shown right) of the saw tooth that you've marked with masking tape.

Continued on page 16

Step 3: Adjust the table

With a cabinet saw, you'll need to move the table. Slightly loosen the four bolts that attach the base to the top, and tap an edge of the table to bring it into alignment with the blade. Check the alignment until it's perfect, tighten the top, and check again.

Align a contractor's saw by moving the blade-support system, as shown *at right*.

On a contractor's saw, loosen the bolts on the blade-support system. Tap the trunnion to align the blade to the miter-gauge slot.

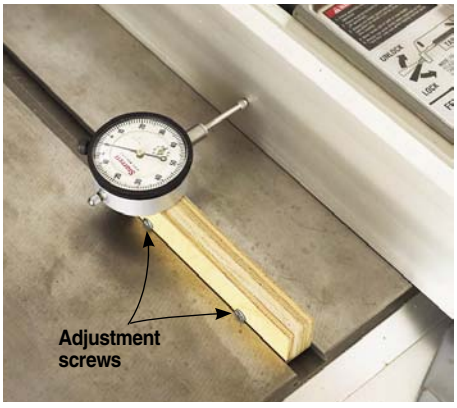
Secrets to blade alignment

The trick to aligning the table and blade is loosening the trunnion bolts as little as possible. That minimizes losing the setting when you tighten the bolts. One more secret: Keeping one of the front bolts quite tight will make that corner act as a pivot point. Once aligned, first tighten the bolt diagonal from the pivot, and then the other two.

Step 4: Align the fence

By aligning the rip fence parallel to the miter-gauge slot, you automatically put the fence parallel to the blade. We like to use a dial indicator for this step because it also reveals whether the fence itself is straight when locked into place.

First, plane a piece of wood until its thickness exactly matches the width of your miter-gauge slot, and screw the dial indicator to it. You can skip the planing by selecting a slightly undersize piece of wood and using flathead screws to achieve a perfect fit, as shown *below*. Zero the dial indicator against the fence at the infeed side of the table, and then check the reading at the outfeed end of the slot. Finally, adjust your fence until the two readings perfectly match.



A dial indicator screwed to a shop-made block helps you check that the rip fence is parallel to the miter-gauge slot.

Step 5: Line up the splitter

Your saw's splitter and anti-kickback pawls are two important components of accurate and safe rip cuts. As its name implies, the splitter keeps the kerf open after the blade makes the cut, preventing pinching that can burn a cut. Follow the simple procedure shown *below* to check that the splitter is centered behind the blade. Loosen the mounting bolts to shift the splitter behind the blade.

The spring-loaded anti-kickback pawls are the pointed guards held against the stock with pressure. The pawls glide over the stock as long as the cut is proceeding normally, but jam into the wood if the blade tries to shoot it backward toward you during a kickback. Prevent an accident by making certain that the pawls operate correctly.

Use a straight piece of wood to check that the splitter is directly behind the blade so it doesn't interfere with the cut.

Step 6: Check your technique

When making rip cuts, you need to perform three movements simultaneously: pushing the stock firmly against the fence at the point just before the blade makes contact, holding the wood firmly downward against the table, and moving it steadily forward. A feather board clamped to the miter-gauge slot supplies pressure against the fence so you can concentrate on the other movements. Whenever possible, use a pushstick to get the wood safely past the blade. A pushstick is especially important for narrow cuts, keeping hands out of harm's way.

It may sound complicated, but it's a lot easier than learning to ride a bicycle. And once you've mastered rip cuts, you'll have a lifelong skill that will help you build projects with better precision.

To rip stock successfully, keep it snug to the fence and saw table. Use a pushstick and feather board to help you do this.

Maybe it's the wood that's causing the trouble

Wood that's cupped, twisted, or bowed invites burned rip cuts. If you're faced with problem wood, you'll find that it's safer to rip it with a bandsaw or jigsaw because there's no risk of kickback. Next, you can flatten each board by using your jointer and thickness planer. Crosscutting wood into slightly overlength blanks before ripping is another technique that minimizes problems–working with shorter pieces also makes each one easier to handle.

Hidden stresses in the wood may cause problems during rip cuts. A tree that grew on a slope, for instance, can produce lumber (or reaction wood) that curls like a spring when cut. And a drying defect called casehardening also can create stresses in the lumber's structure that make the wood move unpredictably when cut. In both cases, turn off the saw, remove the workpiece, and replace it with better stock.

how to clean & lube your tablesaw

Do the moving parts of your most important shop tool offer peak performance with every push of the "on" button? If not, perhaps a little TLC is in order.

After vacuuming most of the dust, blast compressed air into the saw cabinet to dislodge the remaining deposits.

If your tablesaw creaks and groans when you crank the elevation and blade-tilt wheels, it's long overdue for an inspection and tuneup. Outlined here is the procedure that will get your saw moving smoothly again, along with some important safety issues.

First, clean your machine

Begin by unplugging the saw. Remove the throat plate, blade guard, and the blade. Inspect the blade for resin buildup, and clean it if necessary. Make sure that the washer and blade stabilizer (if used) are clean, smooth, and flat.

Removing the drive belt and motor from the back of the saw is a fast and easy step on contractor-style models, and it dramatically improves access to the saw's interior for cleaning and lubrication. A shop vacuum with a crevice attachment will remove most of the chips, and an old paintbrush will help loosen stubborn pockets of dust. Tilt the arbor assembly to dump more dust, and use a couple of blasts of compressed air to complete the job. Make especially certain that you've removed all dust near the stops that limit the tilt control so you'll get full travel.

If the worm gears or the rows of teeth have any residue, scrub them with a brass brush. For really tough build-up, you may have to dip the brush in paint thinner. Keep the solvent away from the arbor bearings, which are usually sealed and need no lubrication. Afterward, wipe any remaining residue from the worm gears in preparation for the next step.

Apply paste wax to the gearing with a toothbrush, and then remove as much as possible. Your goal is to achieve a thin film with no visible residue.

Time for a lube job

After all of the gearing is clean, lubricate it with a non-silicone automotive paste wax applied with a toothbrush. Also wax the curved slots in the front and rear trunnions. Run the tilt and elevation controls through several full ranges of motion, and remove all the wax, leaving only a thin film.

Push a plastic straw tip onto a spray can of white lithium grease, and lubricate the pivots of the arbor assembly (where it swings upward) and the shafts behind the worm gears. This aerosol, available at auto-parts stores, sprays and penetrates like a liquid and congeals into grease. Again, wipe off all the lubricant you can with a rag.

A plastic straw delivers aerosol white lithium grease with precision. This lubricant sprays and penetrates like a liquid, and congeals into grease.

Inspect the arbor flange, making certain that it's clean and smooth. Turn the arbor by hand, and try to wiggle it. Any noise or sideways play indicates a problem with the bearings that requires immediate attention.

Blow dust out of the fence-locking mechanism. Give the fence and the entire surface of the table and extension wings a coat of non-silicone paste wax or a special product like Boeshield T-9. (Visit boeshield.com, or call 800/962-1732.)

For more information on procedures to align the blade, table, fence, and miter gauge, see the article "Tune your tablesaw to perfection" in issue 152 of *WOOD*® magazine.

a shade of difference

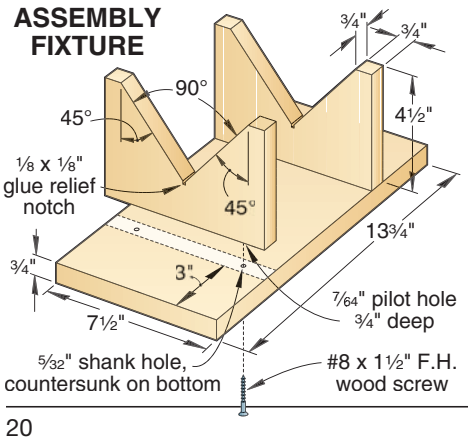
How to make an acrylic light diffuser

If Design Editor Kevin Boyle depended on commercially available lampshades, there would be a much different accent lamp on *page 88*. But rather than being limited by what already exists, he created his own diffuser from inexpensive and readily available materials. You can make one in practically any shape with only a few common workshop tools.

***Note:** These instructions show how to make the square diffuser for the lamp on* page 88. *For other shapes, adjust the angle of the V-shape cutouts in the assembly fixture and the angle of the bevels on the diffuser sides.*

To hold the diffuser parts and keep the corners square while the glue dries, first build the fixture shown in the drawing, *below*. Lay out the V-shape cutouts in the uprights with a combination square, and bandsaw and sand them to the lines. Then cut ⅛×⅛" glue relief notches at the bottom of each cutout. Drill countersunk holes and screw the base to the uprights.

Cut four 5¾×11½" pieces of ⅛" clear acrylic for the diffuser sides. (An 80-tooth triple-chip blade is best for this task, but we had good results with a *sharp* 40-tooth combination blade. As a general rule, more teeth equals smoother cuts in plastic.) Remove the protective covering and "fog" both faces of each piece with your random-orbit sander and a 120-grit disc until the pieces are uniformly translucent. Now cut and assemble the diffuser as shown in the following nine steps.



1 BEVEL-RIP THE SIDE EDGES

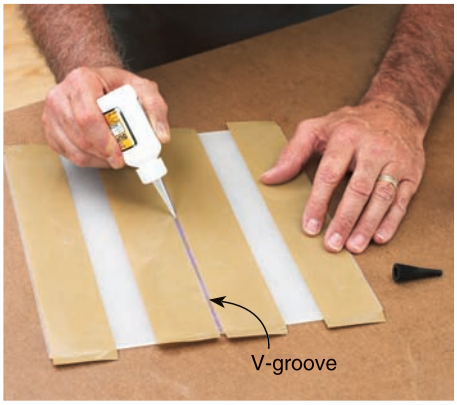
Tilt your tablesaw blade to 45°, and bevel one edge of each side. Then position the fence for a 5 7/16"-wide cut, and bevel-rip the sides to finished width.

2 MASK THE BEVELS

Resand the sides to remove scratches and burrs. To protect the inside surfaces from excess glue, apply plastic packing tape, aligning the tape with the heel of each bevel.

3 JOIN THE SIDES IN PAIRS

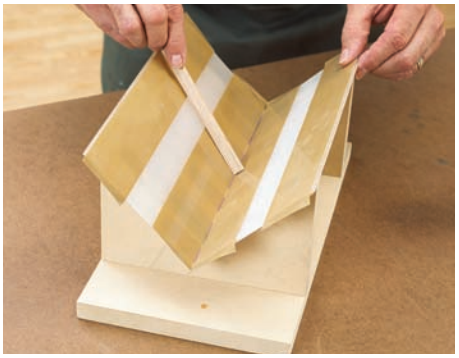
With the inside faces down and the points of the bevels touching, align the ends of each pair of sides with a straightedge and tape them together with masking tape.



4 GLUE THE BEVELS

Place one taped-together pair of sides on your workbench inside face up. Apply a thin bead of gap-filling cyanoacrylate glue to the V-groove formed by the mated bevels.

Continued on page 22



5 FORM THE DIFFUSER HALVES

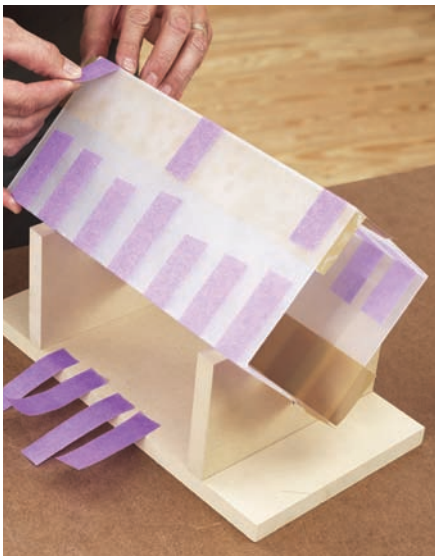
Place the glued side pair in the fixture. Strike off excess glue with a thin wood scrap. Let the glue cure for 30 minutes, and remove the plastic tape. Repeat with the other side pair.

6 JOIN THE DIFFUSER HALVES

Working on a piece of plywood raised on a cardboard box, align the ends of the two diffuser halves with a straightedge, and tape them together with the bevel points touching.

7 AGAIN, GLUE THE BEVELS

Lay the joined halves inside face up on your workbench. Apply glue to the V-groove formed by the mated bevels and to one of the upturned beveled edges.



8 COMPLETE THE DIFFUSER

Place the glued halves in the fixture. Align the ends and secure the top bevels with masking tape. Strike off excess glue and after 30 minutes, remove the plastic tape.

9 FINISHING UP

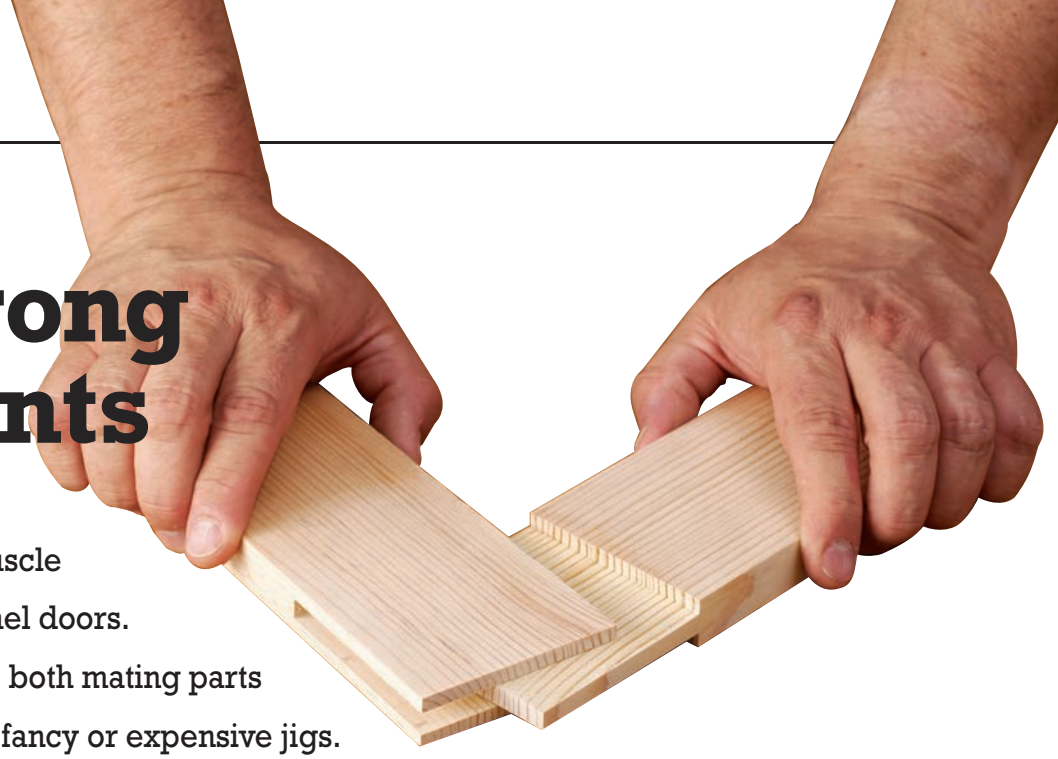
Let the glue cure. Remove the masking tape, and carefully hand-sand the corners with a sanding block and 120-grit sandpaper to soften the edges. Wash the diffuser with warm water and liquid dish washing detergent, rinse, and let it dry.

Source

Gap-filling cyanoacrylate glue. Satellite City Hot Stuff Super "T" gap-filling instant glue no. 121002, $9.95 for a 2-oz. bottle. Packard Woodworks. Call 800/683-8876, or go to packardwoodworks.com.

Illustration: **Roxanne LeMoine**

create super-strong bridle joints



This workhorse provides the muscle and durability to frame-and-panel doors. And the real beauty: You can cut both mating parts easily on your tablesaw without fancy or expensive jigs.

Bridle joints offer the closest thing in joinery to a free lunch. They use a mortise and open tenon that doubles the gluing surface strength you'd get from a half-lap joint, making them strong enough to support the weight of glass panels in a cabinet door. That's the lunch; here's the free part: You can make them easier and quicker than mortise-and-tenon joints.

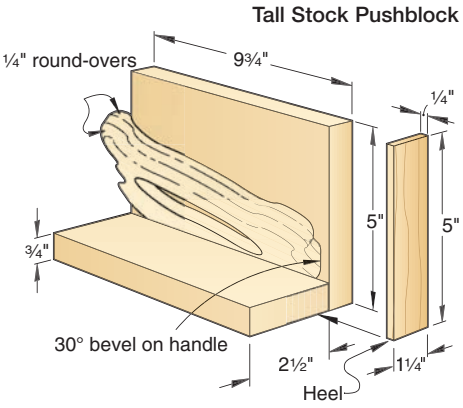
Both types of joints use a tenon on one piece that's inserted into an opening on the other piece. There's one big difference, though: Bridle joints use a mortise that's open on three sides instead of just one. So although bridle joints go together much the same as mortise-and-tenon joints, you don't have to chisel-cut squared-off mortises. The open mortise can be cut with a router and straight bit on narrow stock, a tablesaw-mounted dado blade for wider stock, or just a single carbide-tipped blade (the method you'll learn here). To keep the tablesaw machining safe, we used a simple pushblock designed to support long, vertical stock.

This approach limits the thickness of your workpieces. You can cut only to the height your blade projects above the saw table. For most 10" tablesaws, that's just a little over 3", so we'll practice on standard ¾" stock that's been ripped to 3" wide.

Lay out your cuts

Once you have four practice pieces ripped to 3" wide by 17" long, lay out the joints using a marking gauge, pencil, and combination square. Keep plenty of 3"-wide scraps on hand, like the ones shown *below left*, to make test cuts.

Scraps let you fine-tune fence and blade settings. Once set, make identical mortises and tenons on each frame workpiece.



To help cut long stock, build this pushblock featured in the November 2004 issue (#159), which included a pattern for the handle.

First, divide the four 3×17" practice workpieces into one pair for cutting open mortises on both ends and another pair for cutting tenons. The width of your workpieces determines the depth of your cuts for both the mortises and tenons.

Using a combination square, mark lines on all four sides of both the mortise and the tenon pieces. The lines should be the same distance from the end as the width of your stock. Because we're using ¾"-thick stock, it's easy to divide each edge into three ¼"-thick segments. Mark an "X" or squiggly lines on the waste portions of both the mortise and the tenon pieces, as shown *below*.

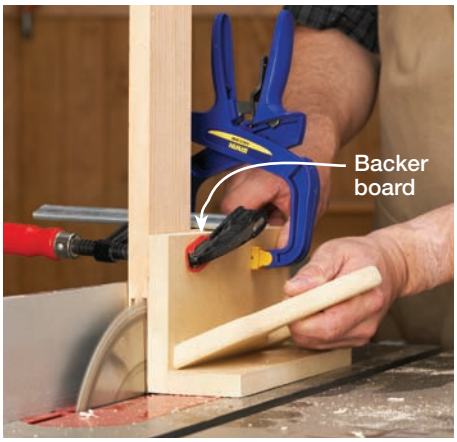
Continued on page 26

Mark all four sides of both ends on each piece. Then lay out and shade the waste areas to be removed.

Make tablesaw tenons

Instead of cutting the tenons last—as you would on a mortise-and-tenon joint—we'll make those first. Start by sawing the deep cuts into the ends. To do this, raise the saw blade to a height equal to the width of your workpiece. Set the fence so that you cut to the waste side of your tenon marks.

Use the pushblock to keep long stock steady and perpendicular to the saw table.



With a pushblock for safety and clamps for stability, it's easy to make deep end cuts on a tablesaw. A backer board scrap behind the workpiece reduces tear-out.

Place a piece of scrap backer board the thickness of your workpiece and height of the pushblock between the workpiece and the heel of the pushblock to prevent tear-out.

Clamp a workpiece to the upright face of the pushblock, and make one pass until the blade cuts through the tenon and scrap, as shown *below left*. Check that the blade barely touches your mark. Make these first tenon cuts on each end of two workpieces.

To complete the tenon, adjust the blade to cut precisely along the waste edge of your mark. The inside corner of your tenon must form a 90° angle.

You're making the equivalent of a rip cut in a 3"-thick piece of lumber, which can tax the horsepower on even a heavy-duty saw.

To finish cutting the tenons, drop your blade height to ¼" and reposition the saw fence until the outside edge of the blade cuts even with your tenon mark. Support your work with a miter gauge fitted with an auxiliary face to prevent tear-out. Then cut both faces of your workpieces, as shown *near left*. If the cut stays within the waste area and comes exactly up to the edge of your cut line, you've correctly adjusted your blade. Cut the tenons on each end of your two workpieces.

Cut the open mortises

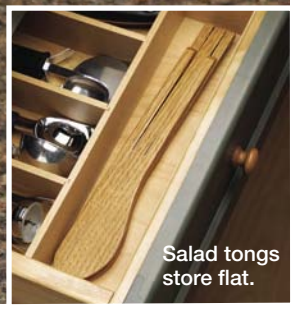
To create open mortises that fit your tenons, cut with caution on the waste side of your workpiece markings to avoid a loose joint. As with the deep cut on the ends of the tenons, support your work by clamping it to the vertical face of the pushblock ahead of a backer board scrap, as shown in the photo *below*

Return the blade to its earlier 3" height, and adjust the saw fence so the blade cuts completely inside the waste area marked on your workpieces. After making your first pass, rotate the workpiece to do the other half of the mortise. Depending on the thickness of your saw blade, you should be able to cut a ¼" open mortise in two to three passes. You want a snug fit, but not so tight that you split the mortise as you assemble the joint. The ends of the mortise and tenon should extend just slightly past the edge grain so you can sand them flush.

The first half of this open mortise already has been cut. To complete this centered mortise, rotate the board to make another cut that's exactly the same distance from the face of your workpiece.

salad tongs
with a little spring

The two halves of this server spring apart in use, yet fold flat for storage. Your microwave holds the key to curving the tong's sprung ends.


Salad tongs store flat.

1 Cut and plane two pieces of stock (we chose white oak) to ¼×1⅞×12". Make a photocopy of the patterns located on the *WOOD Patterns*® insert. Spray-adhere the patterns to the wood blanks folding the patterns over where indicated.

2 Drill a ⅛" pin hole through each blank, where shown on the full-size patterns.

3 Cut the blanks to shape using your bandsaw or scrollsaw. Also cut the long kerfs in each piece, where shown.

4 Using a sanding block, sand the bevels on the hinge ends of the tong halves, where shown in drawing at *right*. Also bevel the opposite ends, where shown.

5 Steam-bend each piece to create the spring mechanism. To do this, saturate six paper towels with water, fold one, and place it between the two tong halves at the kerfed end. Wrap the remaining towels around the paired tongs.

6 Place the tongs in the microwave and run it for two minutes at full power. Flip the tongs over and run them through another two-minute cycle.

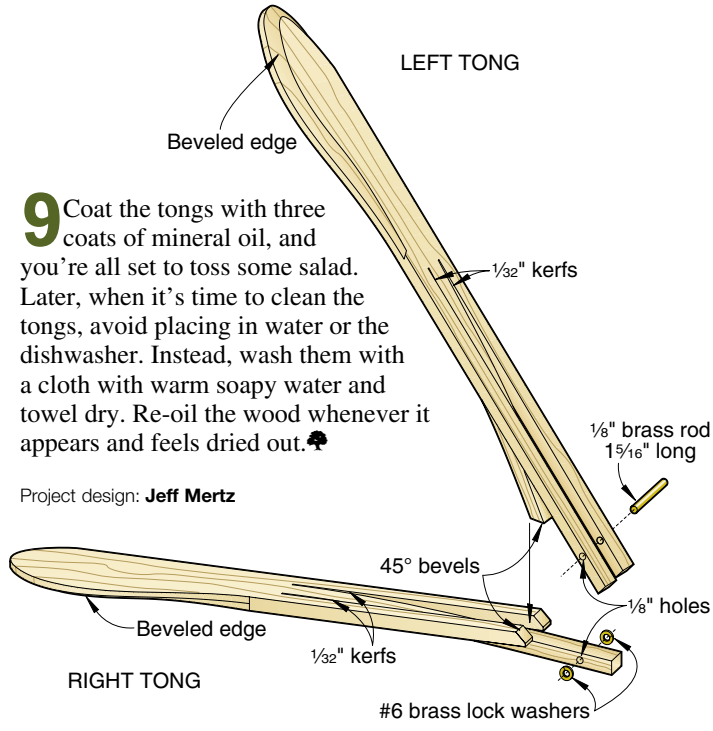
With the beveled face of each piece down, push the microwaved tongs together until they overlap approximately 5".

7 Wearing gloves or oven mitts to protect your hands, remove the paper towels. While the tong halves are still warm and wet, force them together, overlapping them about 5", as shown in the photo *below, left*. Allow the assembly to cool for one hour. Then separate the two halves, and sand each through 220 grit.

8 Hacksaw a 1⁵⁄₁₆"-long piece of ⅛" brass rod and assemble the two blanks, slipping #6 brass washers in place, where shown. Then use a hammer to peen both ends of the rod.

9 Coat the tongs with three coats of mineral oil, and you're all set to toss some salad. Later, when it's time to clean the tongs, avoid placing in water or the dishwasher. Instead, wash them with a cloth with warm soapy water and towel dry. Re-oil the wood whenever it appears and feels dried out.

Project design: **Jeff Mertz**



shop tips

Helping you work faster, smarter, and safer

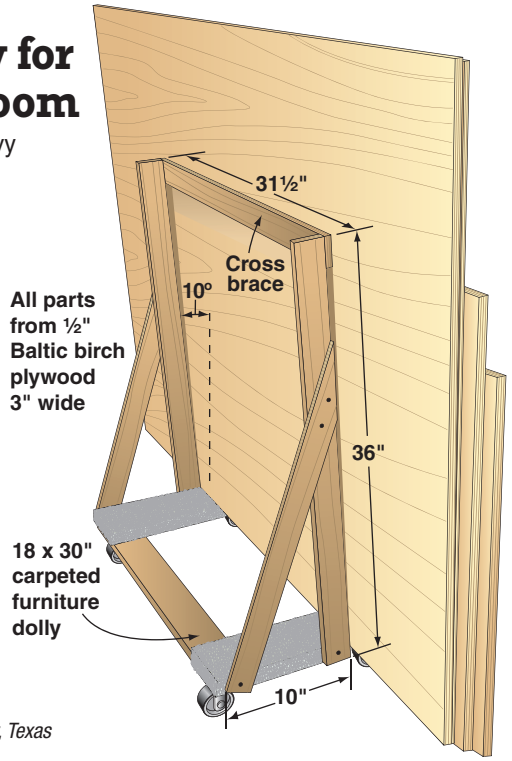
top shop tip

A heavyweight dolly for the big kid's playroom

In my small home shop, handling heavy sheet goods is always an unpleasant challenge because the sheets must go outside when I'm working and back inside at night. To save time and my back, I hit on the idea of modifying a flat furniture dolly with a braced stand made from scrap pieces of lumber.

An 18×30" carpeted furniture dolly is available "off the shelf" at home centers for about $20, will carry up to 300 lbs, and the carpet protects the delicate edges of expensive plywood sheets. Just build the stand, as shown, and angle it back 5–10° degrees from plumb. The stand doesn't need to be terribly strong because the lion's share of the weight is transferred to the dolly.

—Kurt Maurer, League City, Texas



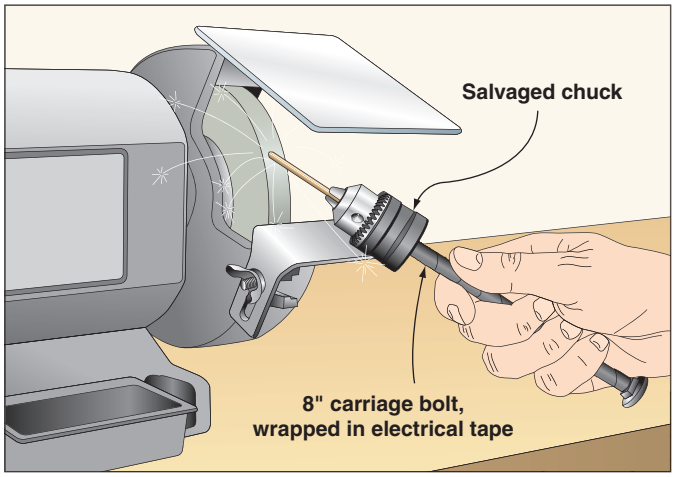
Salvaged chuck safely stabilizes small objects

Holding small parts to a grinding wheel makes me nervous because the force of the wheel can yank the part right out of my hands. And those pieces get hot! Pliers help but can muck up the threads on bolts and threaded rod. A ½" chuck from a dead drill offers the perfect part-holding solution.

I threaded the old chuck onto an 8" carriage bolt, then wrapped the bolt with electrical tape to make it more comfortable to hold. To prevent damage to threaded parts to be ground, I wrap the bottom section of threads with electrical tape, and then tighten the part in the chuck.

The chuck holder works well for sharpening standard drill bits or for sanding dowels. You also can use it to chamfer brass pins.

—Willy Young, Smithville, Tenn.



continued on page 32

Our Winner

Credit Kurt Maurer's mother for instilling in him an unquenchable curiosity. When she showed him Jupiter through a telescope parked on the family's picnic table as a lad, our Top Shop Tip winner grew fascinated with astronomy. Years later, Kurt built his first telescope from wood (shown *above*) and has made dozens since in his one-car garage shop. When he's not 'scoping heavenly bodies, he builds kayaks and dabbles in Egyptology. Curious, indeed.

For sending in the Top Shop Tip, Kurt Maurer earns $350 in tool-organization supplies from Duluth Trading Company. Kudos, Kurt!

Top tips win tools!

Describe how you've solved a workshop dilemma, and you'll earn $75 if it appears here. And, if your tip garners Top Shop Tip honors, you'll also win a tool prize worth at least $250.

Send your best tips, along with photos or illustrations and your daytime phone number, to: **Shop Tips, WOOD Magazine, 1716 Locust St., GA-310, Des Moines, IA 50309-3023**. Or e-mail tips to: shoptips@woodmagazine.com. Remember to include your contact info in the e-mail as well.

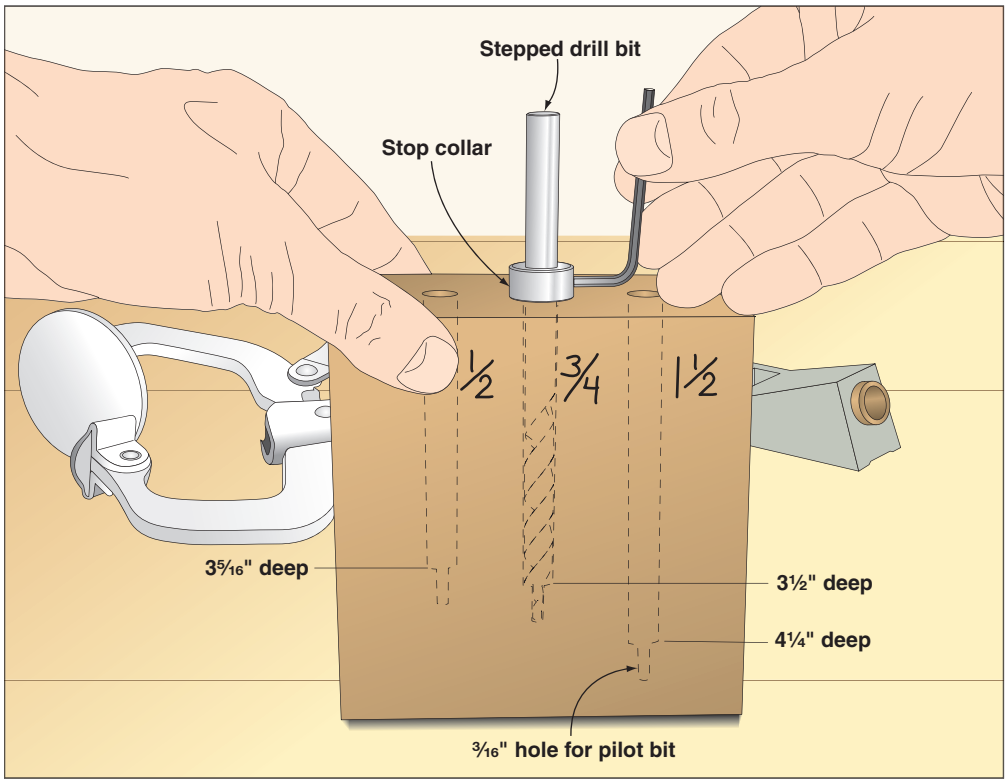
Because we try to publish only original tips, please send your tips only to *WOOD* magazine. Sorry, submitted materials can't be returned.

Pocket-size gauge for setting pocket-hole bits

After reading your review of pocket-hole jigs in issue 152, I bought a jig and was satisfied except for one small problem. I found that changing the depth of the stop collar was awkward because I had to hold the drill bit, a ruler, and the stop collar with one hand while I tightened the collar with the other. To simplify the task, I built this stop collar gauge from scrap ¾" medium-density fiberboard (MDF).

Because the stepped drill bit is ⅜" diameter, I drilled the gauge holes slightly oversize with a 13/32" bit. The drawing at *right* shows how deep to drill the holes to correctly set the bit for ½", ¾", and 1½"-thick materials. I then drilled a 3/16" hole in the bottom of each gauge hole to make room for the pilot bit. To use the gauge, loosen the stop collar, drop the pocket hole bit into the gauge hole, and then retighten the collar.

—Dan Jansen, Sigel, Ill.



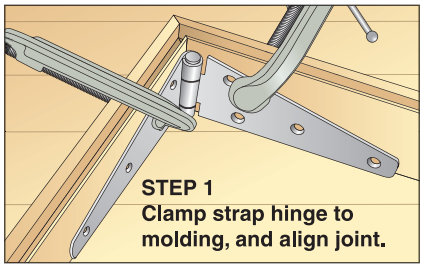
Your framing success hinges on this tip

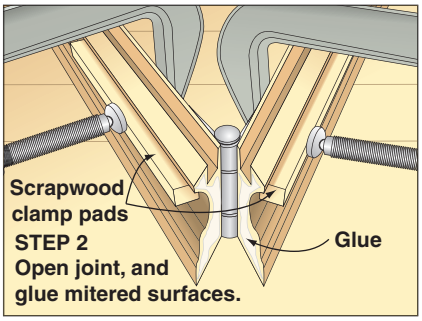
One of my favorite projects is making small boxes using crown moldings. I usually cut the miters with a slight compound angle and had trouble aligning and holding the joint closed during glue-up until I developed the method shown here.

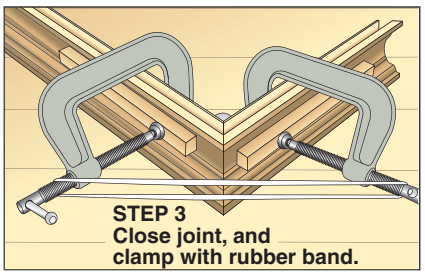
I use a 6" strap hinge as a clamping aid, as shown *below*. First, I align the joint and securely clamp the molding pieces to the strap hinge with C-clamps and scrapwood clamp pads. Next, I carefully open the joint and apply the glue. Finally, I hold the joint closed by wrapping a strong rubber band around the C-clamps' screws.

I use this method to glue opposite corners of the box together. Then I glue the two L-shape parts together with a band clamp. Once you have two firm joints, it's much easier to use the sometimes finicky, but faster, band clamps.

—Paul Boutin, Kelowna, B.C.







See a new
Shop Tip
of the Day at
woodmagazine.com/tips

on-the-mark centerfinder/ trammel

Here's one simple jig that does the work of two. Use it to locate the center of round stock, or use the increment holes to mark different sizes of circles and arcs.

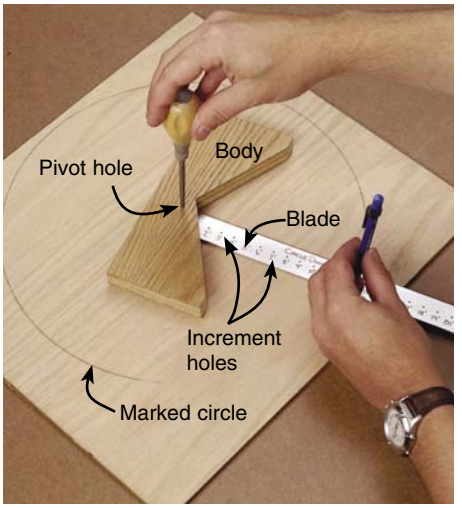
Cut the body to the size and shape noted on the drawing *below* from ¾" stock. Using a hacksaw, crosscut a piece of ⅛×1" aluminum bar stock to 12" in length for the blade. Mark the screwhole centerpoints and increment hole centerpoints on the blade, where dimensioned on the Hole Location Detail. Using your drill press, drill three countersunk screwholes through the blade. Then drill the increment holes and the pivot hole. Drilling through the aluminum will create rough surfaces, so sand the aluminum smooth with 220-grit sandpaper.

Use a square to positon the blade perpendicular to the end of the body at the apex of the V-shaped notch. Using the screw holes in the blade as guides, drill pilot holes into the wood body. Screw the two pieces together.

Using the tool

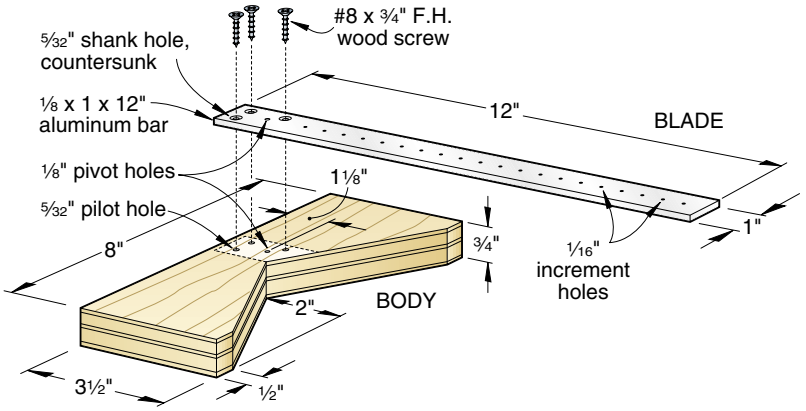
To find the center of round stock, such as the bowl blank shown *above*, rotate the body of the tool around the diameter of the stock and mark a pair of roughly perpendicular intersecting lines as shown. The intersection marks the centerpoint.

To use as a trammel, fit an awl, nail, or other pointed object through the pivot hole in the body and blade. Using one of the previously drilled increment holes in the bar, rotate the tool around the trammel pivot point to mark a circle or arc, as shown, at *right*.

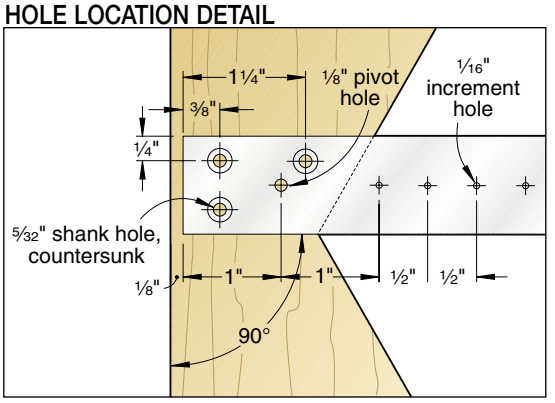


Project design: **Bob Settich**

CENTERFINDER / TRAMMEL



HOLE LOCATION DETAIL



super-flexible closet storage system

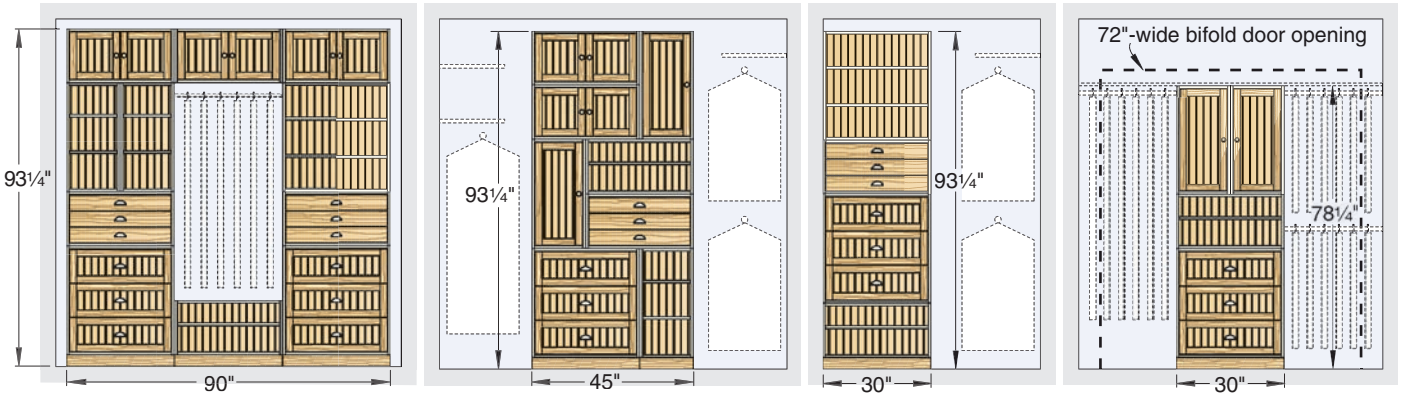
MIX CASES TO SUIT YOUR NEEDS

For perfect alignment, build a single base for adjacent cases. Where the top of a case is below eye level, add a finished top.

OUT-OF-THE-CLOSET FURNITURE

By adding a finished top and making a deeper base, the closet system cases can do double-duty as freestanding furniture.

With choices of three case sizes, three drawer sizes, and two door sizes, you can maximize the storage possibilities of any closet in your home. The system looks so good you can even let it out of the closet and use it as freestanding cabinet storage.



To strike a balance between good looks and low cost, solve your closet storage problems by building this modular system from inexpensive materials found at most home centers. Make use of some mail-order fasteners specially suited for this type of construction (see **Source** on *page 46*), and see how quickly you can complete your closet upgrade.

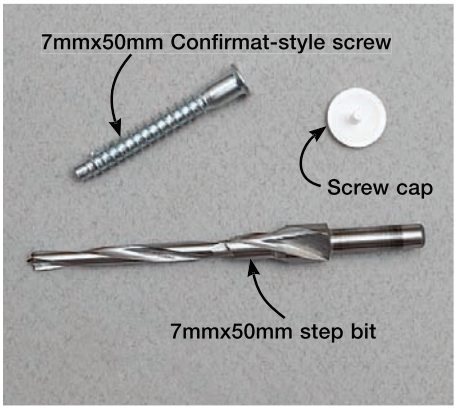
We'll show you how to plan your installation. The drawings *above* show just a few of the combinations. We've even created cutting lists to help you organize your work. They'll save time by eliminating repeat machine setups. When the cases are complete, it's a snap to stack them, bolt them together, and conquer closet clutter.

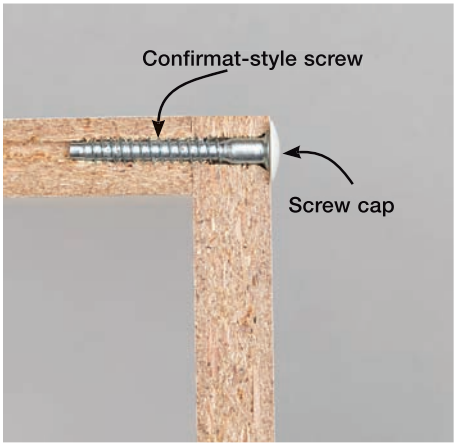
First, let's take a look at the closet storage system materials, hardware, modules and finishing options, and a guide for planning your installation.

System materials and hardware

▪ Confirmat-style screws

Specially designed for fastening particleboard and medium-density fiberboard, these screws use a special step bit that drills a pilot and countersunk shank hole in one operation. Push-in plastic caps cover exposed screw heads for a finished look.



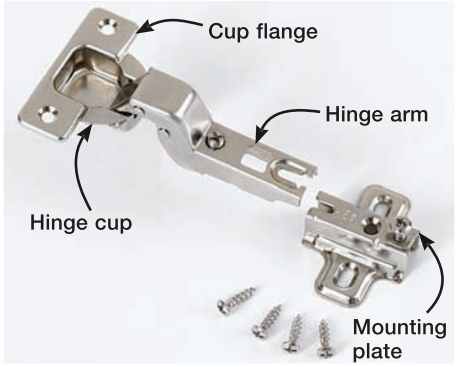


▪ Melamine-coated particleboard

Available in ¾×15⅞×96" pre-edged panels, this finished-width material eliminates hours of cutting, drilling, and edging. Use the panels predrilled for 5mm shelf supports for case sides and the undrilled panels for case tops, bottoms, and shelves.

▪ European-style hinges

With in-out, up-down, and side-to-side adjustment, these fully concealed hinges ensure perfect door alignment.

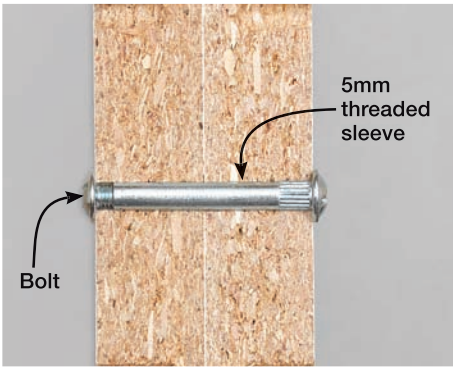


▪ Beaded birch plywood

An alternate to plain plywood, this ¼"-thick material comes in 4×8' sheets and makes attractive and inexpensive case backs and door and drawer front panels. It readily accepts paint, stain, and clear finishes to give you many finishing options.

▪ Case connecting bolts

Use this 5mm threaded-sleeve-and-bolt combination to fasten together stacked and adjacent cases for stability.



System modules

The three case modules are all the same depth, so they are identified by width and height. Each module can be outfitted with shelves, drawers, or doors, yielding the following size designations and configurations.

Note: *For easy reference, shelves, drawers, and doors are designated by nominal, not actual, dimensions. (Nominal dimensions are rounded to whole numbers.)*

30wX30"h CASE WITH THREE 30wX10"h DRAWERS

30wX30"h CASE WITH TWO 30" SHELVES

30wX15"h CASE WITH THREE 30wX5"h DRAWERS

30wX15h" CASE WITH TWO 15wX15"h DOORS (ONE 30" SHELF INSIDE)

30wX15"h CASE WITH ONE 30" SHELF

15wX30"h CASE WITH THREE 15wX10"h DRAWERS

15wX30"h CASE WITH A 15wX30"h DOOR (TWO 15" SHELVES)

15wX30"h CASE WITH TWO 15" SHELVES

Finish options

The combinations of materials and finishes for your drawer fronts and doors are up to you. The three drawers in the case, shown at *right*, feature the following finishes:

Top: Maple-framed beaded birch plywood drawer face finished with satin polyurethane.

Center: Poplar-framed beaded birch plywood drawer face finished with white semigloss paint.

Bottom: Oak-framed beaded birch plywood drawer face finished with Zar Salem Maple stain and satin polyurethane.

Note: *For cases in your closet storage system with open shelves, cut the case backs from ¼" beaded birch plywood, and finish them to match the drawer fronts and doors.*

Planning your installation

Make several copies of the cabinet system modules and one copy of the planning grid on the *WOOD Patterns®* insert. Measure the inside width and height of your closet, and draw it to scale on the grid. (Each square on the grid represents 2".) Then measure the closet door opening and draw it with dashed lines on the grid, making sure it is properly oriented side-to-side. Cut out the system modules and arrange them on the planning grid, trying various combinations until you settle on an arrangement that fills your needs and fits the space. Make sure all doors and drawers will clear the closet door opening.

To find the number of parts you'll need to build all your modules, refer to the **Materials List/Cutting List** for the cases on *page 42*, for the drawer boxes on *page 43*, and for the drawer faces and doors on *page 44*. Following the three-step instructions on each list, fill out the **Cutting List** portion. Note that some of the cases, drawer boxes, drawer faces, and doors share the same parts.

SHOP TIP

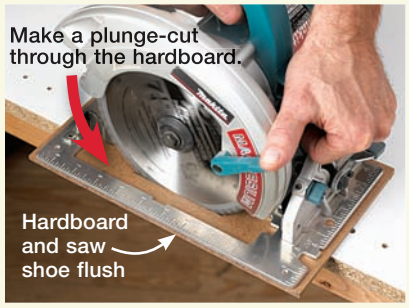
Cutting melamine-coated particleboard panels

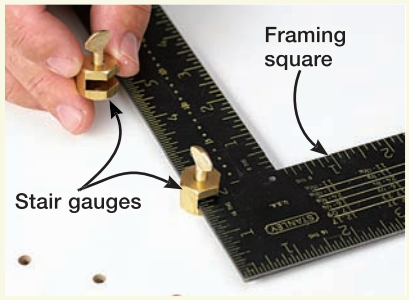
Use these tricks to cut case parts from the ¾×15⅞×96" panels.

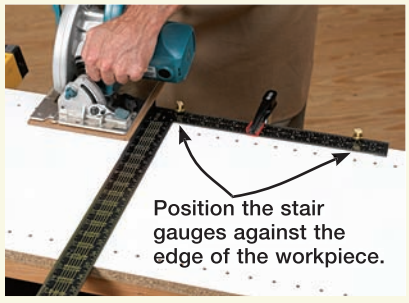
For easier handling, support the panels on sawhorses with a couple 2×4s and cut parts to finished length with a portable circular saw.

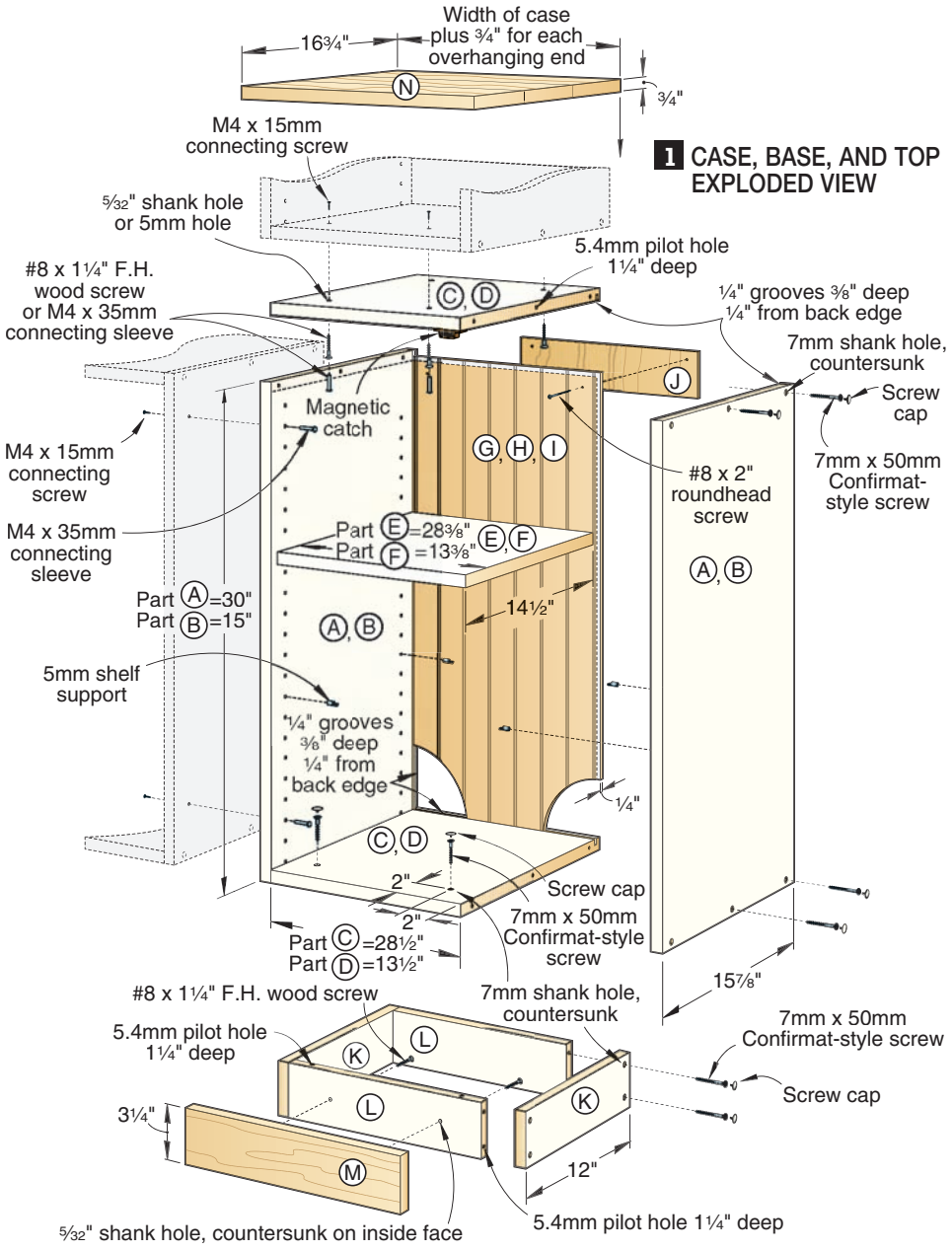
To reduce chipping, use a 60-tooth carbide-tipped blade, and fit your saw with a zero-clearance auxiliary shoe. To do this, cut a piece of tempered hardboard about the same size as the saw shoe. Then raise the blade above the shoe and adhere the hardboard to it with double-faced tape, carefully aligning the edges. Set the saw on your workpiece so the blade clears the edge. Now, with the saw running, plunge the blade through the hardboard, as shown *below*, *top*.

For a simple right-angle crosscut guide, buy a pair of stair gauges (about $5 at hardware stores) for your framing square. Clamp the stair gauges to the short blade of the square, as shown *below*, *middle*. Adjust the saw blade to cut about ⅞" deep, position the square to align the saw blade with your cutline, clamp it to the panel, and crosscut your case parts, as shown, *below*, *bottom*.









1 CASE, BASE, AND TOP EXPLODED VIEW

Let's get started

Make the cases

1 Working off the cutting list, crosscut the case sides (A, B) from predrilled melamine-coated panels, and the tops and bottoms (C, D) and shelves (E, F) from undrilled panels. See the **Shop Tip**, at *left*, for help in cutting the 96"-long panels. When crosscutting the sides to finished length, make sure you have left and right pairs and the top shelf-support holes are centered ⅝" from the ends so the shelves will align properly. To avoid mistakes during assembly, mark the top ends "left" and "right." Rip the shelves to width, retaining the finished edge.

2 Measure the exact thickness of the plywood for the case backs (G, H, I) and cut ⅜"-deep grooves ¼" from the back edges of the sides, tops, and bottoms, where shown on **Drawing 1**. Then to quickly and accurately mark screw-hole centers on the sides, see the **Shop Tip** on *page 42*.

3 From ¼" beaded birch plywood, cut the backs (G, H, I) to size. Finish them to match the door and drawer fronts.

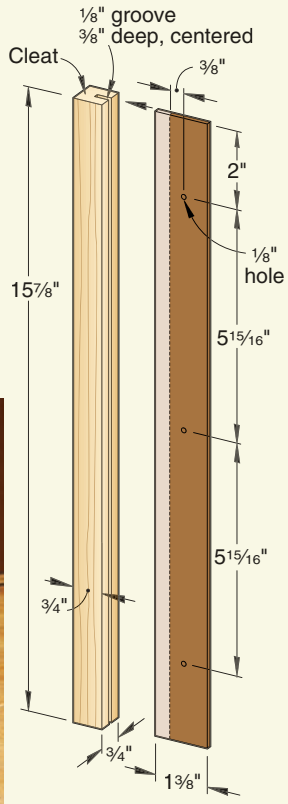
4 To assemble the cases, first identify the parts for each case by reviewing the **Cutting List** columns under the case sizes. The white squares you've filled in identify the parts for that size case. (See "Planning your installation," *opposite page*.) Then pick the appropriate number of each part. Now squeeze glue into the side, top, and bottom grooves, and assemble the cases, as shown in **Photo A** on *page 42*. The case fillers (J) will be cut to size later during installation.

SHOP TIP

Speed assembly by pre-marking screw hole centers

Each case is fastened together with a dozen screws. That's a lot of screw-hole locations to mark on case sides even for a moderate-size closet. And because the caps covering the screws on exposed sides will show, you'll want the holes uniformly spaced. For fast assembly, make the marking guide shown on the drawing at *right*, and pre-mark hole centers on the sides with an awl, as shown in the photo *below*.

CASE SCREW HOLE MARKING GUIDE



Materials List

Step 1 Using your Planning Grid, count the number of each case by size. Enter the numbers in all the open white boxes in the *vertical columns* marked Column 1 under the appropriate case size.
Step 2 Add the numbers in each *horizontal row* and enter the sum in the open box in Column 2.
Step 3 Multiply the number in Column 2 by the number in Column 3 and enter the result in Column 4. This is the number of each part needed. For the total number of 30" shelves (E), add the numbers in the two rows of Column 4 and enter the sum in Column 4a.

Cutting List

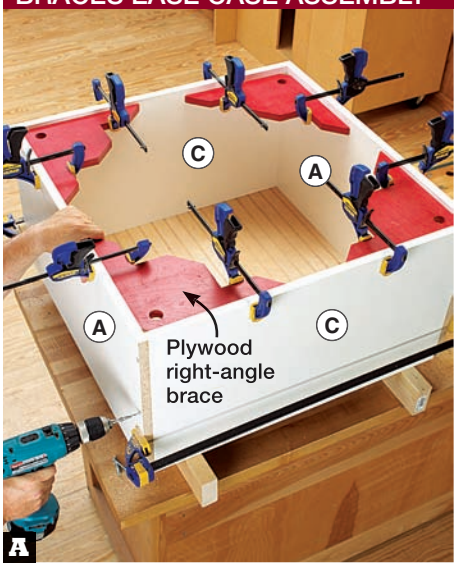
Column	1			2		3		4	4a
Cases and shelves	FINISHED SIZE T	W	L	Matl.	30w×30"h case	30w×15"h case	15w×30"h case	Total assemblies using this part	Multiply	Number of parts per assembly	Equals	Total parts	Total parts
A 30" sides	¾"	15⅞"	30"	DMP					×	2	=		
B 15" sides	¾"	15⅞"	15"	DMP					×	2	=		
C 30" top and bottom	¾"	15⅞"	28½"	MP					×	2	=		
D 15" top and bottom	¾"	15⅞"	13½"	MP					×	2	=		
E 30" shelf	¾"	14½"	28⅜"	MP					×	2	=		
									×	1	=		
F 15" shelf	¾"	14½"	13⅜"	MP					×	2	=		
G 30w×30"h back	¼"	29¼"	29¼"	BBP					×	1	=		
H 30w×15"h back	¼"	29¼"	14¼"	BBP					×	1	=		
I 15w×30"h back	¼"	14¼"	29¼"	BBP					×	1	=		
J case filler	¼"	3"	**	BBP						†			
Bases													
K base sides	¾"	3¼"	12"	MP						2			
L base front and back	¾"	3¼"	**	MP						2			
M base trim	¾"	3¼"	**	C						1			
Tops													
N *top	¾"	16¾"	**	EC						†			

*Part initially cut oversize. See the instructions.
**Part dimension varies. See the instructions.
†Number of parts varies. See the instructions.

Materials key: DMP–drilled melamine-coated particleboard, MP–melamine-coated particleboard, BBP–beaded birch plywood, C–choice of species, EC–edge-joined choice of species.

Supplies: #8×1¼" flathead wood screws, #8×2" roundhead screws, 5mm shelf supports. See items in **Source**, *page 46*.

BRACES EASE CASE ASSEMBLY



With the back glued into the grooves, clamp together the case sides, top, and bottom, using plywood right-angle braces to square them. Then using the special step bit, drill holes and drive the Confirmat-style screws.

Now make bases and tops

1 Measure the height of the baseboard in your closet. If the baseboard is taller than the 3¼" height of the bases, increase the width of the base parts so the bottom edge of the bottom cabinet will clear the baseboard. Check the planning grid to make sure any upper cabinet doors will clear the closet opening. Now cut the base sides (K) and base front and back (L) to size. Clamp the bases together using plywood right-angle braces, drill screw holes where shown on **Drawing 1**, and drive the screws.

Note: *For two or more adjacent cases, make a single base. To figure the length of the front and back (L) for a base, add the total width of the case or cases and subtract 1½".*

2 Measure the outside width of the base, and cut the base trim (M) to size from material matching your drawer front and door frames. Finish-sand the trim.

3 Edge-join boards matching your drawer front and door frames to make an oversize blank for the top (N). Trim the top to finished size and finish-sand it.

Note: *The top (N) is optional when the top of the top case is above eye level. To determine top length, measure the total width of the top case or cases, and add ¾" for each overhanging end. Where a shorter case abuts a taller one, omit one side overhang. (See the inset photo on* page 38.*)*

4 Finish the base trim (M) and top (N) to match your drawer fronts and doors. Clamp the base trim to the base. Then drill countersunk screw holes through the base front and into the base trim, where shown on **Drawing 1**, and drive the screws.

Build the drawer boxes

1 From ½"-thick stock (we used poplar), cut the sides (O, P) and fronts and backs (Q, R, S) to size. Then from ¼" plywood, cut the bottoms (T, U) to size. Finish-sand the drawer parts.

2 Following the two steps of **Drawing 2**, cut the drawer joints in the sides (O,

Materials List

Drawer boxes	FINISHED SIZE T	W	L	Matl.
O 10" sides	½"	7¼"	14½"	P
P 5" sides	½"	3"	14½"	P
Q 30w×10"h front and back	½"	7¼"	27"	P
R 15w×10"h front and back	½"	7¼"	12"	P
S 30w×5"h front and back	½"	3"	27"	P
T 30" bottom	¼"	14"	27"	BP
U 15" bottom	¼"	12"	14"	BP

Materials key: P–poplar, BP–birch plywood.

Blade: Stack dado set.

Supplies: 14" bottom mount drawer slides.

Cutting List

Column	1			2		3		4
	30w×10"h drawer	15w×10"h drawer	30w×5"h drawer	Total assemblies using this part	Multiply	Number of parts per assembly	Equals	Total parts
O 10" sides			■		×	2	=	
P 5" sides	■	■			×	2	=	
Q 30w×10"h front and back		■	■		×	2	=	
R 15w×10"h front and back	■		■		×	2	=	
S 30w×5"h front and back	■	■			×	2	=	
T 30" bottom		■			×	2	=	
U 15" bottom	■		■		×	2	=	

Step 1 Using your Planning Grid, count the number of each drawer by size. Enter the numbers in all the open white boxes in the *vertical columns* marked Column 1 under the appropriate drawer size.
Step 2 Add the numbers in each *horizontal row* and enter the sum in the open box in Column 2.
Step 3 Multiply the number in Column 2 by the number in Column 3 and enter the result in Column 4. This is the number of each part needed.

P) and fronts and backs (Q, R, S), where shown on **Drawing 3**. Then measure the thickness of the ¼" plywood drawer bottoms (T, U), and cut ¼"-deep grooves ¼" from the bottom edges of the sides, fronts, and backs.

3 Glue and clamp the drawer boxes together, and set them on a flat surface to dry. Check the boxes for square by measuring the diagonals. Equal diagonals means square drawers. With the glue dry, apply a clear finish. (We used satin polyurethane.)

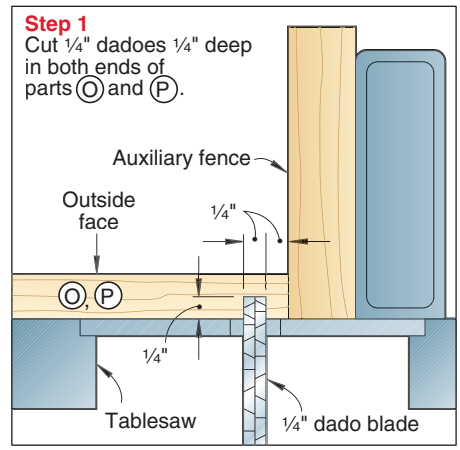
Add drawer faces and doors

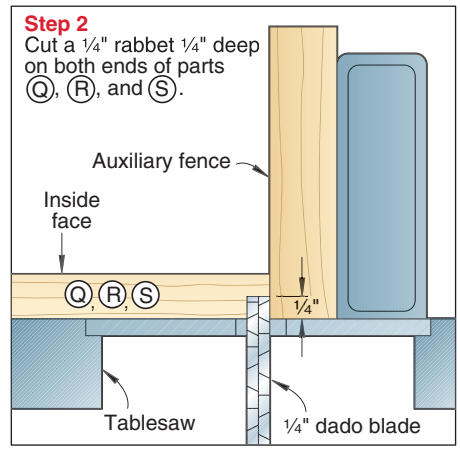
1 Because the parts of the frame-and-panel drawer faces and doors are machined the same, avoid repeat setups by building them at the same time. Cut the stiles (V, W, X) and rails (Y, Z, AA) to size. Then cut the panels (BB, CC, DD, EE) to size.

2 Measure the exact thickness of the plywood panels and cut ⅜"-deep grooves centered in the inside edges of the stiles (V, W, X) and rails (Y, Z, AA), where shown on **Drawings 3**, **3a**, and **4**.

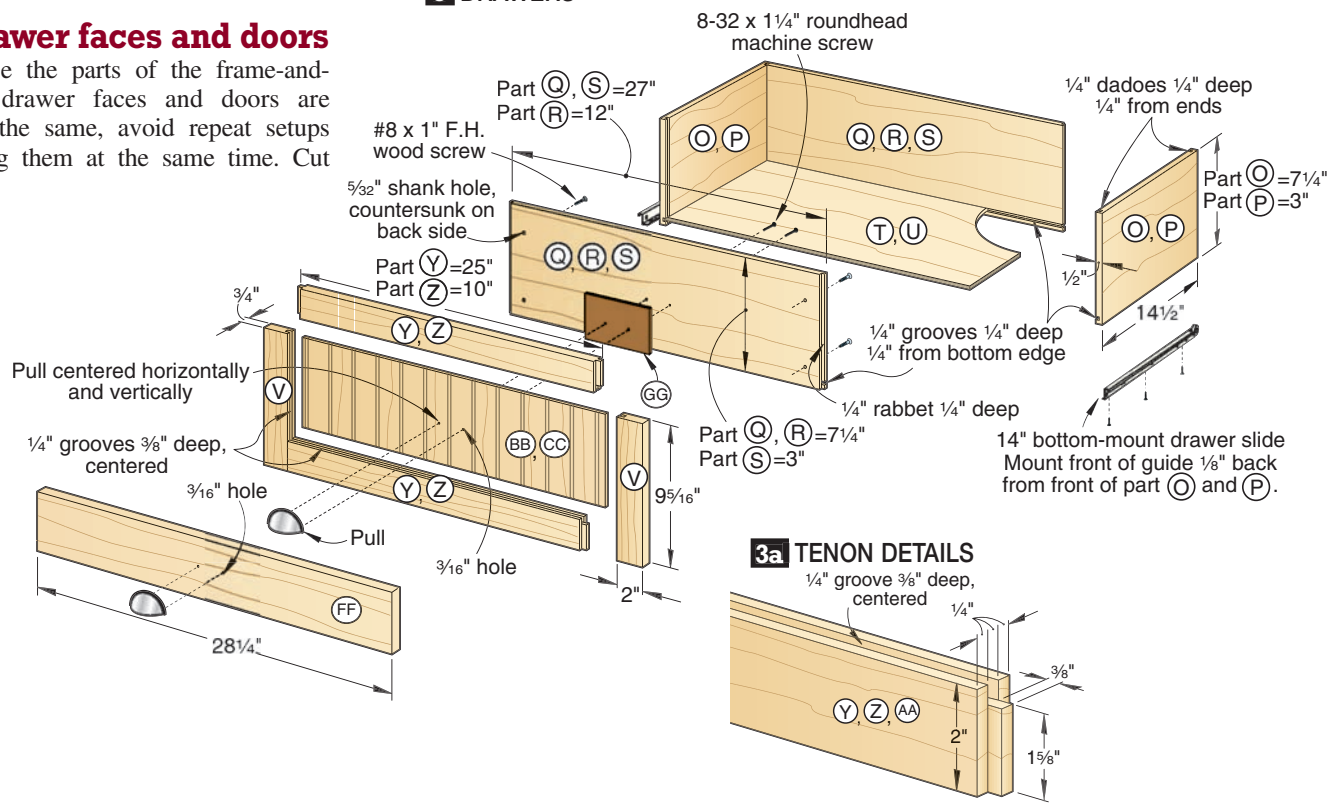
3 Install a dado blade in your tablesaw and form tenons, shown on **Drawing 3a**,

2 CUTTING LOCK-RABBET JOINTS





3 DRAWERS


8-32 x 1¼" roundhead machine screw
Part Q, S =27"
Part R =12"
#8 x 1" F.H. wood screw
5⁄32" shank hole, countersunk on back side
Part Y =25"
Part Z =10"
¼" dadoes ¼" deep ¼" from ends
Part O =7¼"
Part P =3"
¼" grooves ¼" deep ¼" from bottom edge
¼" rabbet ¼" deep
Part Q, R =7¼"
Part S =3"
14" bottom-mount drawer slide
Mount front of guide ⅛" back from front of part O and P.
Pull centered horizontally and vertically
¼" grooves ⅜" deep, centered
3⁄16" hole
Pull
3⁄16" hole
9 5⁄16"
2"
28¼"

3a TENON DETAILS

Materials List

Step 1 Using your Planning Grid, count the number of each drawer face and door by size. Enter the numbers in all the open white boxes in the *vertical columns* marked Column 1 under the appropriate drawer face or door size.
Step 2 Add the numbers in each *horizontal row* and enter the sum in the open box in Column 2.
Step 3 Multiply the number in Column 2 by the number in Column 3 and enter the result in Column 4. This is the number of each part needed.

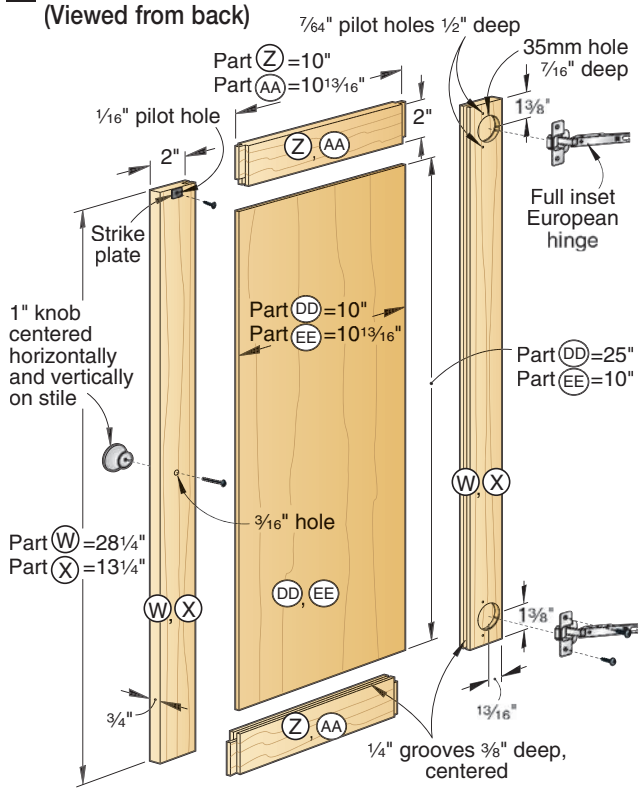
Drawer faces and doors	FINISHED SIZE T	W	L	Matl.	Column 1: 30w×10"h drawer face	15w×10"h drawer face	30w×5"h drawer face	15w×30"h door	15w×15"h door	Column 2: Total assemblies using this part	Multiply	Column 3: Number of parts per assembly	Equals	Column 4: Total parts
V 10" face stiles	¾"	2"	9⅝"	C							×	2	=	
W 30" door stiles	¾"	2"	28¼"	C							×	2	=	
X 15" double door stiles	¾"	2"	13¼"	C							×	2	=	
Y 30" face rails	¾"	2"	25"	C							×	2	=	
Z 15" face and door rails	¾"	2"	10"	C							×	2	=	
AA 15" double door rails	¾"	2"	10 13/16"	C							×	2	=	
BB 30w×10"h face panel	¼"	25"	6 1/16"	BBP							×	1	=	
CC 15w×10"h face panel	¼"	10"	6 1/16"	BBP							×	1	=	
DD 15w×30"h door panel	¼"	10"	25"	BBP							×	1	=	
EE 15w×15"h door panel	¼"	10 13/16"	10"	BBP							×	1	=	
FF 30w×5"h solid face	¾"	4 5/16"	28¼"	C							×	1	=	
GG filler	¼"	3"	5"	H							×	1	=	

Materials key: C–choice of species, BBP–beaded birch plywood, H–hardboard.

Blade and Bit: Stack dado set, 35mm Forstner bit (See **Source**, *page 46*.).

Supplies: #8×1" flathead wood screws, pull, #8-32×1¼" roundhead machine screws, full inset European hinges, 1" knob, magnetic catch, double-faced tape.

4 DOORS
(Viewed from back)



on the ends of the rails (Y, Z, AA) to fit the stile (V, W, X) grooves, where shown on **Drawings 3** and **4**.

4 Finish-sand the panels (BB, CC, DD, EE), and glue and clamp together the drawer faces and doors. Cut the solid faces (FF) to size.

5 Drill 3/16" holes for the pulls in the drawer faces and knobs in the doors, where shown on **Drawings 3** and **4**. To mark hinge cup hole centers, make the guide shown on **Drawing 5**. Then mark hole centers, as shown in **Photo B**, where shown on **Drawing 4**. Chuck a 35mm Forstner bit in your drill press, and drill 7/16"-deep holes.

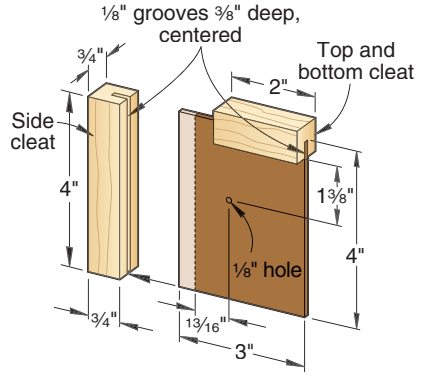
6 Finish-sand the drawer face and door frames and the solid drawer faces, and apply the finish of your choice.

Install drawers and doors

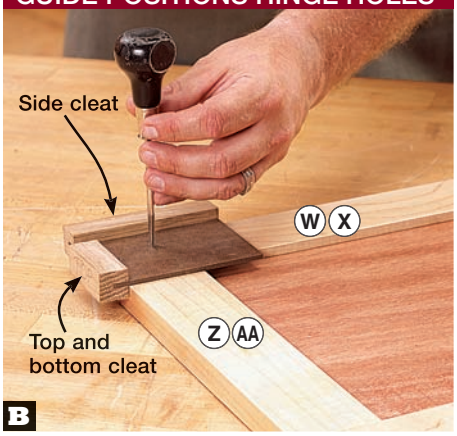
1 Mount the drawer slide case members, where shown on **Drawing 6**. To make quick and accurate work of this task, see the **Shop Tip**, *below*. Then mount the drawer members, as shown in **Photo C**.

2 To mount the drawer faces, slide the drawer boxes into the case. Then apply fillers (GG) to the backs of the drawer face panels (BB, CC), where shown on **Drawing 3**, and mount the faces on the drawer boxes, as

5 HINGE CUP HOLE MARKING GUIDE



GUIDE POSITIONS HINGE HOLES



With the guide cleats against the corner of the door, use an awl to mark hinge cup hole centers on the inside faces of the stiles.

SHOP TIP

Use a scrap spacer for dead-on drawer guide installation

When mounting drawer slides in the cases, you have to be dead-on accurate and able to repeat this accuracy for all the slides. To do this, lay the cabinet on the side. Then cut a scrap spacer the correct length for mounting the uppermost slides. With the spacer against the case bottom and the slide against the spacer and set back 7/8" from the front edge of the side, drill pilot holes and drive the screws, as shown at *right*. After mounting all the slides at this height, cut the spacer to length for the next highest group of slides, and repeat.

BOTTOM SLIDES SELF-ALIGN

C

With the bottom-mount feature guaranteeing vertical alignment, space the slides ⅛" from the front end of the drawer sides, drill pilot holes, and screw them in place.

FILLERS AND SHIMS GUARANTEE PERFECT DRAWER ALIGNMENT

D

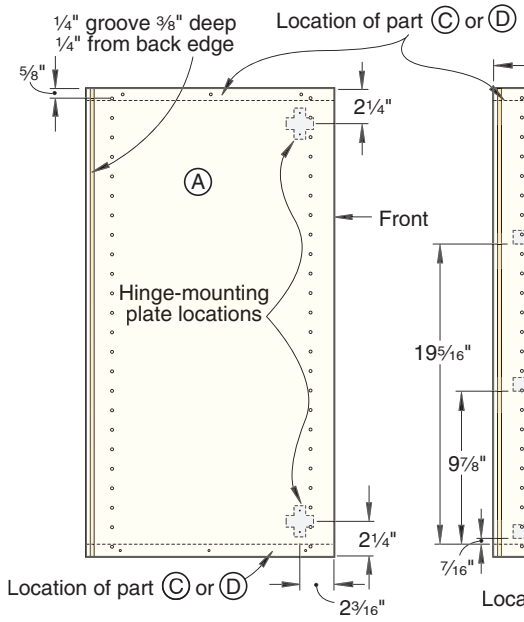
To keep the drawer face panels from bowing in when installing the pulls, double-face tape a ¼"-thick filler (GG) to the inside face of each panel, centered on the pull screw holes.

E

Positioning the drawer faces with ⅛" shims, stick them to the drawers with double-faced tape. Then using the pull holes as guides, drill through the fillers and drawer fronts.

shown in **Photos D** and **E**. Open the drawers, and clamp the faces in place. Remove the drawers from the case, marking the locations on the drawer backs. Drill countersunk holes through the drawer fronts (Q, R, S) and into the drawer face stiles (V) or solid faces (FF), where shown on **Drawing 3**, and drive the screws. Install the drawer pulls with 1¼"-long machine screws.

3 Press the hinge cups into the 35mm holes in the doors, making sure the cup flange is parallel to the door edge. Using the holes in the flange as guides, drill pilot holes and drive the screws. Screw the hinge-mounting plates to the case sides, where shown on **Drawing 6**. Slide the hinge arms into the mounting plates, and tighten the screws. Use the adjusting screws, shown in **Photo F,** to align the doors flush with the case edges and leave a uniform gap all around. Install magnetic catches, where shown on **Drawing 1**.

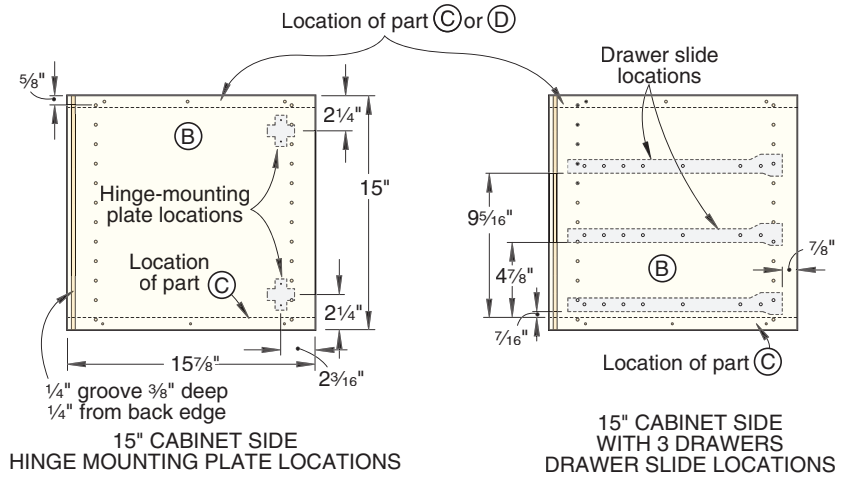


ULTIMATE ADJUSTABLE HINGES

F

For perfect door alignment, European-style hinges offer in-out, up-down, and side-to-side adjustments at the turn of a screw.

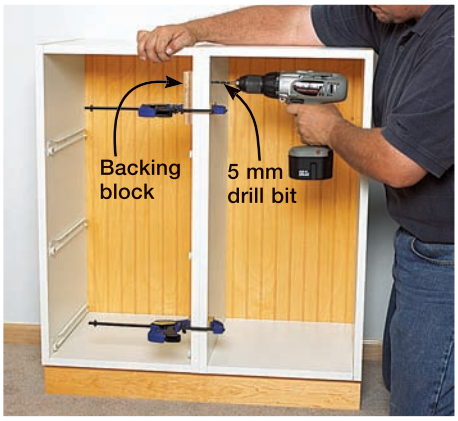
6 PARTS VIEW



Complete your closet

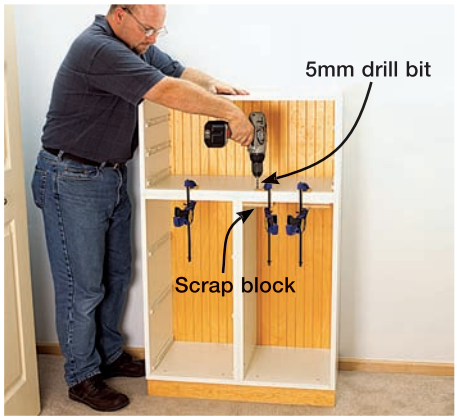
Prepare the inside of the closet by removing existing shelves, shelf cleats, and hanging rods. Patch any holes, and prime and paint the walls. If you wish, reinstall a shelf and closet rod, positioning them so the rod is centered 82" from the floor. Remove all drawers and doors from the cases. Now, follow these steps to install your closet storage system.

Step 1 Position the base side-to-side, where indicated on your planning grid. To avoid moldings and carpet tack strip, space the base 2¼" away from the back wall.



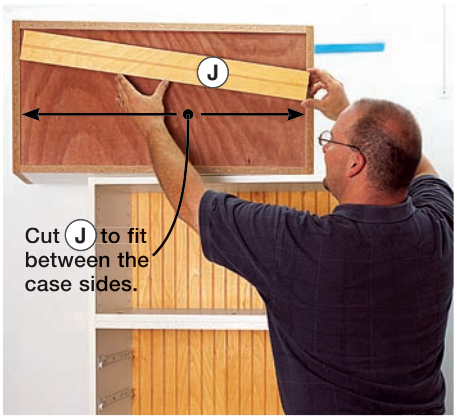
Step 2 Place the bottom cabinets on the base and clamp them together. Drill 5mm holes, backing them with a scrap block. Fasten the cabinets with connecting bolts.

Step 3 With the case backs against the wall and flush with the base sides, drill screw holes through the case bottoms and into the base front. Drive the screws.



Step 4 Center the next case on the previous ones and clamp it in place. Drill 5mm holes, backing them with scrap blocks, and fasten the cases with connecting bolts.

Step 5 Before fastening the last case to the top of the stack, adhere a strip of masking tape to the wall above the top edge. Then mark the locations of wall studs on the tape.



Step 6 To reinforce the back of the top case, cut a 3"-wide case filler (J) from ¼" plywood to fit in the rear recess between the sides. Secure it in place with double-faced tape.

Step 7 Fasten the top case to the stack. Transfer stud locations to the case back, and drill screw holes through the back and filler and into the studs. Drive the screws.

Reinstall the drawers and doors. Install shelf supports and shelves. Cover the exposed heads of the Confirmat-style screws with plastic screw caps. If your installation includes a top (N), clamp it in place, drill countersunk screw holes through the case tops (C, D) and into the top, where shown on **Drawing 1**, and drive the screws. Install additional closet rods between the side walls and cases. For hanging shirts, blouses and jackets, install rods 41" and 82" from the floor. For hanging dresses, install a rod 64" from the floor. Now with a place for everything, put everything in its place.

Written by **Jan Svec**
Project design: **Jeff Mertz**
Illustrations: **Roxanne LeMoine**

Source

Hardware. 7mm×50mm Confirmat-style screw starter kit no. 7050-CSP-A [Includes 7mm×50mm step bit no. MMD-0750, 7mm×50mm Confirmat-style screws no. 7050-CSP-C (100), white screw caps no. 7051-CAP (100), 1" PoziDrive bit no. HPD-0210, 2" PoziDrive bit no. HPD-0220], $34.15; M4×15mm connecting sleeves no. PCF-M435, $5.32 (25); M4×15mm connecting screws no. PCM-M415, $1.21 (25); 5mm brad-point bit no. BRD-M050, $6.92; 35mm Forstner bit no. CMF-0035, $15.90. McFeely's. Call 800/443-7937, or go to mcfeelys.com.

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mail-order wood

It just might be the best way to go.

Some of us are fortunate to live near a reliable source of quality hardwood. But if you're like many woodworkers, the search for hardwood often serves as an obstacle to starting a project. Luckily for us, mail-order sources have filled the niche.

We recently looked at today's mail-order lumber resources, including some of the companies listed on *page 50*. You'll also find wood at eBay.com (search "lumber" or "turning blocks").

Four reasons to buy

Why would someone prefer buying wood by mail rather than purchasing it locally? Afterall, there's the expense of shipping, and wood weighs a lot. You can't inspect the stock in person, and you may have to wait a few days for it to arrive.

To arrive at some answers, we asked Keith Stephens. You might know Keith as the woodworking-woods forum moderator at *WOOD* Online. More importantly, Keith is also owner of Woodworkers Source, a mail-order lumber store based in Phoenix, Arizona. His five top reasons to buy mail-order wood:

1. Availability. If you don't live near a hardwood retailer, mail order is a great alternative. Or, as some very thankful woodworkers report, the only alternative.

2. Cost. Unlike a local lumberman, who perhaps can justify ordering only 500 board feet of padauk at a time, a large mail-order dealer buys padauk by the container load. That kind of volume buying earns a discount, which gets passed along to you, the woodworker.

3. Bottom line: Often woodworkers are surprised they can get comparable cost through the mail, even factoring in shipping costs. (See "mail-order lumber put to the test" at *right*.) When comparing cost to local sources, factor in your time spent selecting and hauling materials.

To be a smart buyer, become familiar with how companies list the board-foot cost. Some advertise prices based on 100 board feet. For smaller wood orders, they may add 10 cents per board foot. Another may have a higher cost per board foot, but offer a discount for breaking through the 100-board-feet threshold.

4. Selection. At big-box stores or home centers, consider yourself fortunate to find any hardwoods beyond red oak or poplar. However, the well-stocked lumberyard of-

mail-order companies may offer as many as 100 varieties, including tropical exotics and highly figured domestic woods.

5. Convenience. Rather than trek to the hardwood store (often in another town), you can place an online or phone order at your convenience (Web sites are open 24/7), and then wait for the lumber to show up at your door. Several Web sites we visited let you easily view the cost of extra services, including S4S (Surfaced Four Sides) and rush delivery.

How much lumber do I need?

"Add up the board feet you need," Steve Wall suggests. "Then order 50 percent more than the project calls for. That figures out to be a 33-percent waste factor."

Remember that "waste" doesn't necessarily end up in the scrap bin; it likely will have use in a smaller project. "It's not like you're buying bread," Steve added, "your lumber will keep for another project."

Before you finalize your order, inquire how many board feet you'll need to qualify for a volume discount. To lower costs, consider adding your order to that of another woodworker.

Talkin' lumber

"The buyer needs to have some knowledge of wood," Keith noted. "For example, 12"-wide red oak is not a problem. But 12"-wide white oak, that's a problem. And not everyone knows that cherry boards don't arrive all cherry red at your shop—it's pale until finished and then darkens with sunlight."

Steve Wall of Steve H. Wall Lumber in Mayodan, North Carolina, concurs that some buyers lack familiarity with hardwood. "Our biggest nightmare occurs when someone asks for a specific board—like a 12"-wide oak board 7' long—just like it's shown in a project cutting diagram. Someone who has only shopped for pine at the local home center may not realize that hardwood is random lengths and widths.

"I recommend common grade to woodworkers building small crafts projects. They'll always get nice figure around knots and defects."

If you're fuzzy on the lumber-buying terminology used in the industry, check out www.woodmagazine.com/woodwords. There, you can raise your comfort level with terms such as FAS (First and Seconds, the highest-quality boards), S4S, and the fine differences between curly and fiddleback grain.

How to get exactly what you need

You can't exactly select each board through mail-order, but making specific requests will lead to higher satisfaction. Do you need

MAIL-ORDER LUMBER PUT TO THE TEST

As a quality test, we ordered 20 board feet of cherry from Woodworkers Source. To avoiding tipping our hand to this impending article, the order was shipped to the Urbandale, Iowa, home of Karl Ehlers, our art director. We provided no special requests for grain, width, or straight-line milling. The bundled cost of $159 included shipping, which computed to $7.95/board foot S4S. (The best comparable local quote was $5.95 plus local sales tax for 13⁄16" S3S cherry.)

The 56-pound project pack was wrapped securely in protective cardboard and sealed with tape. We asked Master Builder Chuck Hedlund—our staff's pickiest wood shopper—to assess the quality of eight boards, which varied in width from 3½" to 6". "The ⅞" thickness is a plus," Chuck observed. "That will give me plenty of latitude for surfacing and removing any planing marks. I could use five of the boards in project construction requiring good on both faces. The other three boards pass my test for good on one side.

"Most have nice color and grain throughout. All in all, for today's cherry, this is good stuff," Chuck said.

Our order of 20 board feet of cherry arrived with a protective layer of cardboard (double layer at ends) and sealed in plastic.

After unwrapping your hardwood, be sure to check each board for flatness and flaws.

boards with two good faces? Will matching grain and color be critical for a tabletop? You can't go wrong by describing your project to the customer service representative and explaining your special criteria. In fact, some online wood sources have fields for you to enter special requests.

Did you realize that most mail-order companies stock at least three varieties of mahogany? To eliminate any doubt (particularly with exotic woods), refer to the wood's Latin name. (Woodworkers Source lists Latin names on its Web site.)

Instead of asking for oak, be prepared to specify white oak or red oak (which may include pin oak, black oak, or others). Further, if you request quartersawn white oak, will you be disappointed if there aren't ray flecks? If so, speak up when ordering.

"If you're determined to find an prized piece of wood at the lowest price, you may have conflicting objectives," Keith said. "Before you purchase that special piece of bird's-eye maple, ask for photos. Woodworkers Source sends out photos to help customers see what they're buying."

Good sources for mail-order hardwood

Berea Hardwoods
877/736-5487; PenKits.com

Heritage Building Specialties
800-524-4184; Heritagewood.com

Steve H. Wall Lumber Company
800/633-4062; WallLumber.com

West Penn Hardwoods
888-636-9663; WestPennHardwoods.com

Woodworkers Source
800/423-2450, ext. 110;
WoodworkersSource.net

Some money-saving considerations

■ **Shipping.** Make sure to factor shipping costs into your purchase price. Many special bundles—sometimes called project packs—include shipping costs.

Your source may offer discounts for shipments meeting a minimum weight, which will help contain costs. For example, 30 board feet weighing 114 pounds shipped from Phoenix, Arizona, to Austin, Texas, costs $50.74 via UPS ($1.69 per board foot). However, 228 pounds to the same destination ships for $70.43 or $1.17 per board foot. So there may be a compelling reason to bump up your order.

UPS shipments must not exceed a length and girth of 165 inches; most mail-order wood sellers offer common carrier delivery (motor-freight companies, such as Yellow Freight) for heavier or longer bundles delivered to your door.

■ **Shop specials.** You're likely to find some specials at the beginning and end of the busiest woodworking months—September through April.

If you're an "upside down" woodworker (you often find the wood first, then figure out what to build), you may already be hopelessly hooked on closeouts and specials promoted on some mail-order Web sites. There are bargains to be had.

■ **Guarantee.** Inquire whether your mail-order source offers a satisfaction guarantee. With the shipping and restocking costs, most mail-order companies work hard to match or exceed expectations. You may pay for return shipping costs if you have to reject lumber.

■ **Humidity adjustment.** After you unwrap your shipment and examine the boards, make sure you allow the stock to gain or lose moisture in your environment. We suggest stickering the lumber (stacking the boards on spacer strips to let air circulate around them for at least seven days), which will allow the boards to reach the equilibrium moisture content (EMC) of your shop.

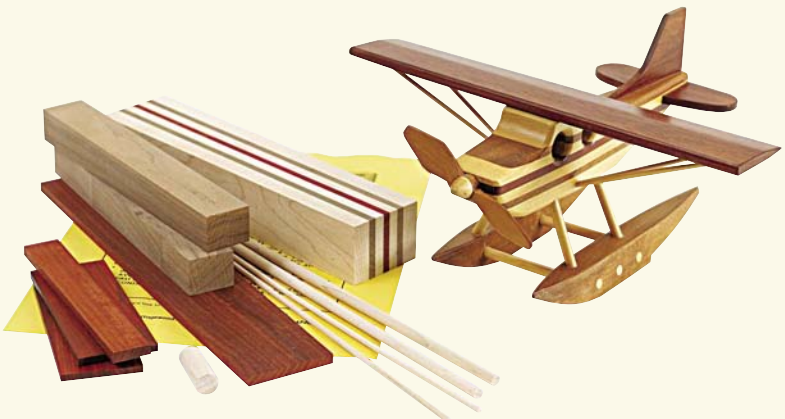
Project Packs: How much do you value time?

As a reader service, *WOOD*® magazine frequently works with Heritage Building Specialties (800/524-4184) to assemble all the required hardwood for a project, such as the Accent Lamp on *page 88*. Typically, these are projects that require non-standard thickness (½"-thick stock, for example) or exotic hardwoods.

When the lumber package arrives at your doorstep, you'll have all the wood listed in the Materials List—sanded to the proper thickness—but oversize in width and length for final trimming and machining. Depending on the need, the kit may also include dowels or specialty hardware. The lamp project pack, for example, includes four pieces of clear acrylic for the shade.

Bottom line: You'll save time searching for the suggested woods, plus you'll avoid the time and extra effort to resaw or plane stock to the proper thickness. For a look at projects available as lumber kits, visit www.heritagewood.com.

When you order the Heritage project pack for the Picture Frame Bookends (Issue #159), the packet includes acrylic plastic (cut to size) and dowels.



When you order the Heritage project pack for the Toy Float Plane (issue #127), the complete package includes pre-laminated fuselage material (3/16", ¼", and ½" pieces) and hardwood dowels.

accurate-alignment biscuit-joiner jig

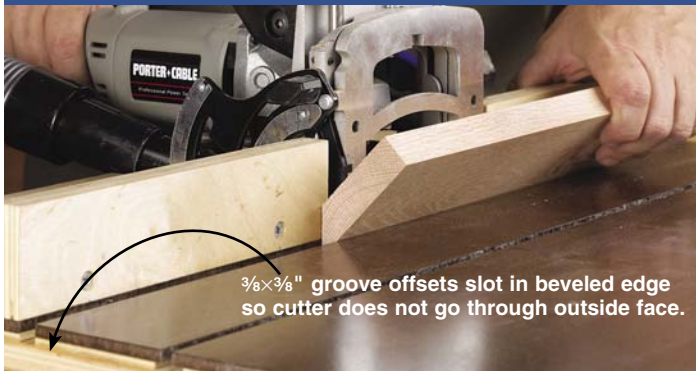
Mount your biscuit joiner to this handy jig, and step up to a new level of convenience and precision when cutting slots in ¾" material.

4 SITUATIONS WHERE THIS JIG UPS YOUR ACCURACY

EDGE-TO-EDGE JOINT

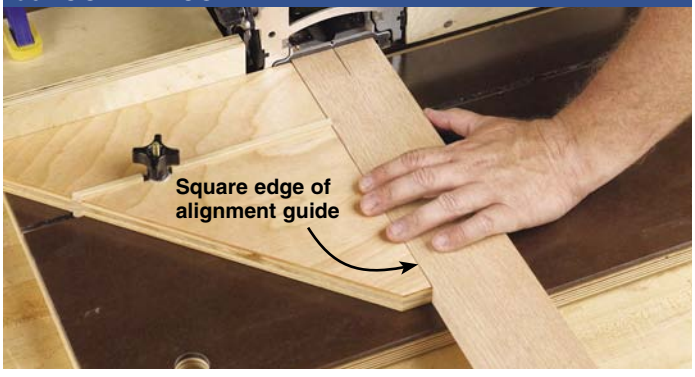
With the jig clamped to your workbench, position the workpiece against the fixed fences. Align the marks, and cut the slot.

BEVELED-EDGE JOINT



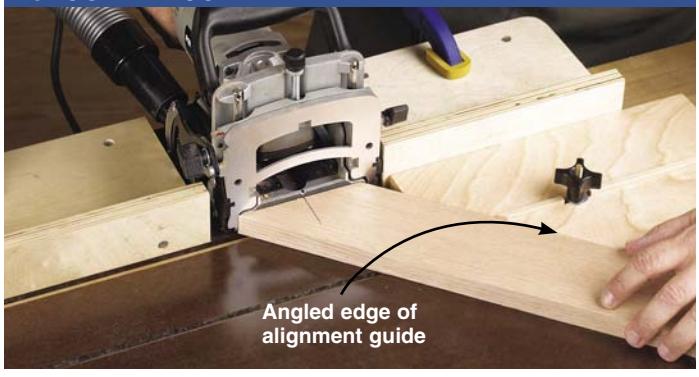
Hold the part against the fixed fences with the beveled edge in the ⅜×⅜" groove. This offsets the slot toward the inside face.

90° CORNER JOINT



For a 90° joint, place the workpiece against the square edge of the 90°/45° alignment guide. Position the guide to align the cut.

45° CORNER JOINT



To cut a slot in a 45° mitered end, position the workpiece against the angled edge of the guide. Flip the guide to cut the other end.

NOW BUILD ONE FOR YOUR SHOP

For the board feet of lumber and other items needed to build this project, see *page 54*.

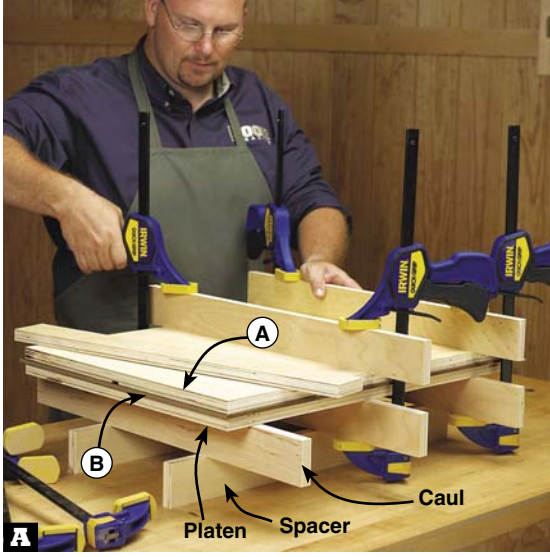
Start with the base

1 From ¾" plywood, cut the base (A) to the finished size of 18×23¾". From ¼" tempered hardboard, cut the top (B) to 18¼×24".

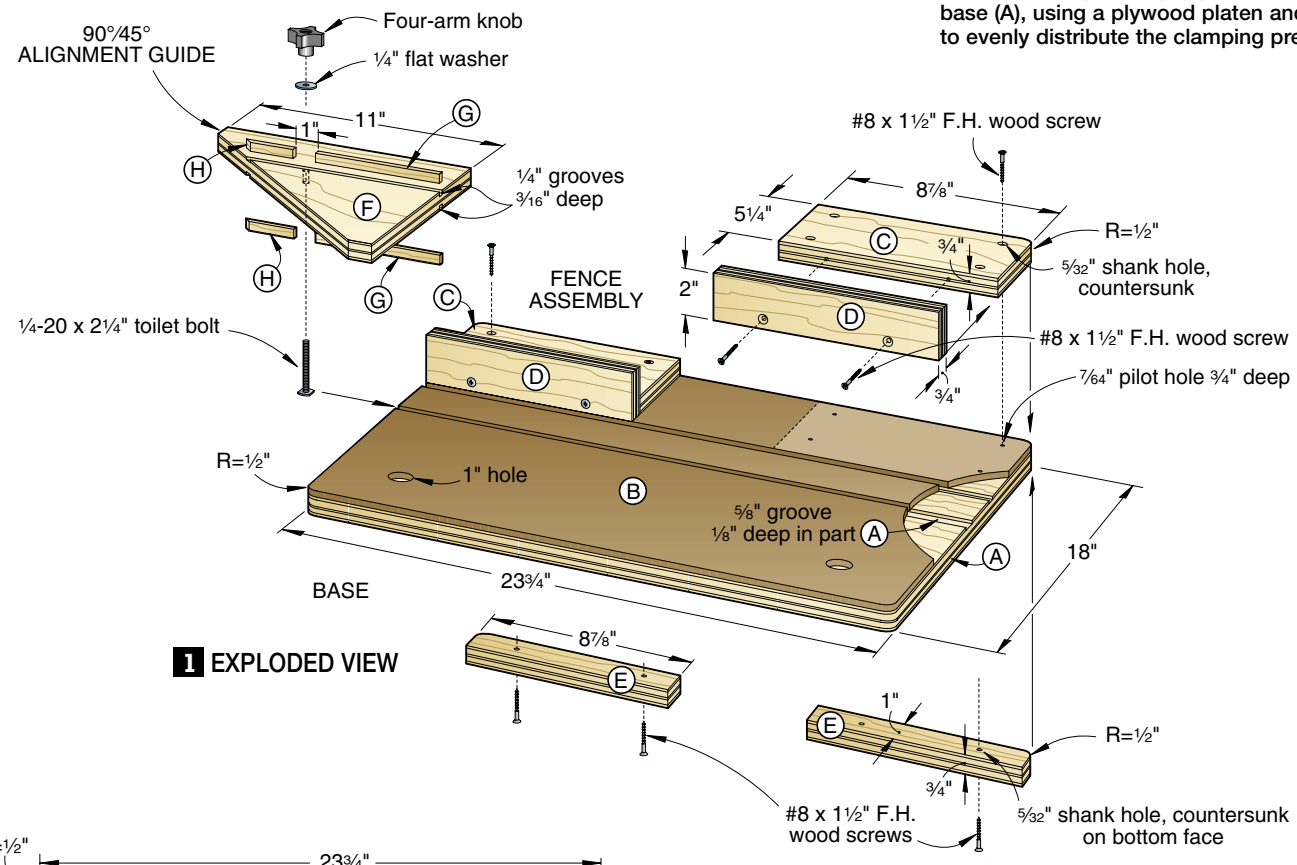
2 Using a dado blade in your tablesaw, cut a ⅝" groove ⅛" deep in the top of the base, where shown on **Drawing 1** and dimensioned on **Drawing 2**.

3 Using scrap ¾" plywood for a platen, cauls, and spacers, as shown in **Photo A**, adhere the oversize top (B) to the base (A) with yellow woodworking glue. Center the top with an equal overhang on all edges. After the glue dries, trim the top flush with the base using a flush-trim bit in your router.

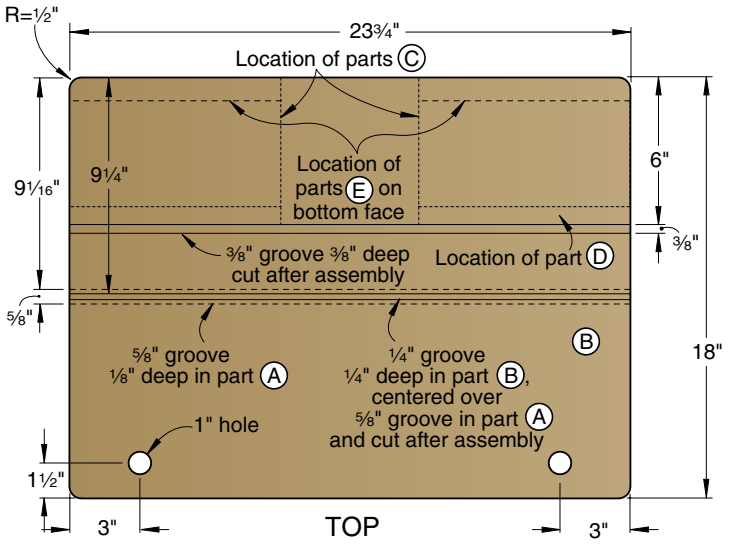
4 Refit your tablesaw with a ¼" dado blade. Then cut a ¼"-deep groove in the top (B) centered over the ⅝" groove in the base (A), where dimensioned on **Drawing 2**. (This forms a T-slot for the alignment-guide toilet bolt, where shown on **Drawing 1**.) Now change to a ⅜" dado



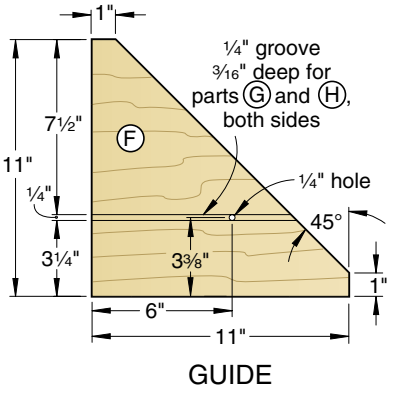
Glue and clamp the top (B), centered, to the base (A), using a plywood platen and cauls to evenly distribute the clamping pressure.



1 EXPLODED VIEW



2 PARTS VIEW



blade, and cut a ⅜"-deep groove in the base/top, where dimensioned on **Drawing 2**. (This groove holds parts in position when plunging slots in beveled edges.)

5 From ¾" plywood, cut the brackets (C), fences (D), and cleats (E) to the sizes listed in the **Materials List**. Position the fences against the brackets, where shown, with the ends and bottoms flush. Drill mounting holes, and drive the screws.

6 Clamp the fence assemblies (C/D) in position on the base/top (A/B), where shown on **Drawings 1** and **2**, with the front face of the fences flush with the back edge of the ⅜" groove. To keep the fences aligned, clamp a scrap piece of ¾" plywood as a straightedge to the front of the fences. Check that your biscuit joiner fits in the opening between the fences with the biscuit-joiner fence flush against the straightedge. If your joiner has a dust-collection port, make sure you have sufficient clearance for the hose attachment. If needed, trim the fence assemblies to fit the joiner, and then remove the joiner.

7 With the straightedge clamped to the fences, glue and clamp them to the top (B). Drill mounting holes through the brackets (C) into the base/top, and drive the screws. Remove the straightedge.

8 Position the cleats (E) on the bottom of the base (A), where shown on **Drawings 1** and **2**. (The cleats position the jig against the front edge of your workbench.) Drill mounting holes, and drive the screws.

9 Draw ½" radii on the corners of the base/top and brackets (C). Cut and sand the radii smooth.

10 Using a Forstner bit, drill 1" holes (for hanging the jig) through the base/top, where dimensioned on **Drawing 2**. Use a backer to prevent tear-out.

Add the alignment guide

1 From ¾" plywood, cut the guide (F) to size. Then cut a ¼" groove ⅜" deep on both faces of the guide, where dimensioned on **Drawing 2**. Now drill a ¼" hole through the guide, centered in the groove, where dimensioned.

2 Mark the 45° angle on the guide. Bandsaw or jigsaw to the line, and sand the edge smooth.

3 To form the long and short guide bars (G, H), plane or resaw a piece of ¾×2×16" hardwood (we used maple) to ¼" thick to glide smoothly in the ¼" groove in the top (B). Rip a ⅜"-wide strip from the piece. Then crosscut two 5½"-long long bars and two 2¼"-long short bars from the piece. Glue the bars in place in the guide (F), leaving a 1" space between them, where shown on **Drawing 1**. After the glue dries, trim the ends of the short guide bars flush with the angled edge of the guide using a fine-tooth saw.

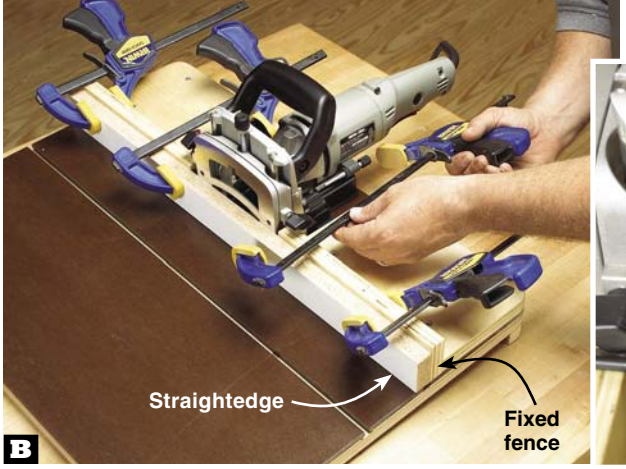
Finish up, and rig the jig

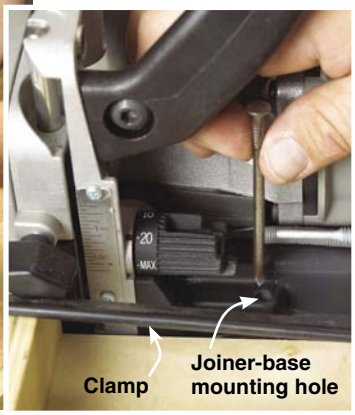
1 Finish-sand the base assembly and alignment guide, and remove the dust. Apply three coats of satin polyurethane, sanding to 220 grit between coats.

2 To mount your biscuit joiner, reclamp the straightedge to the fences. Then position the joiner on the jig, and mark centerpoints for the joiner-base mounting holes on the top (B), as shown in **Photo B**. (Due to the tight space with some joiners, you may need to use a nail instead of an awl to mark the centerpoints.) Drill shank holes through the base/top assembly, and countersink them on the bottom face. (The screws must not protrude from the base.) Fasten the joiner to the assembly with suitable hardware. (To mount our Porter-Cable Model 557 joiner, we drilled ⅜16" shank holes through the base assembly and secured the unit with ⅜16×2½" flathead machine screws and ⅜16" flat washers and nuts.)

Note: *If your biscuit joiner does not have mounting holes, check if it has a removable baseplate attached with machine screws. If so, drill holes in the jig base assembly matching the baseplate hole pattern, and mount the unit using the same size machine screws except 1" longer to account for the thickness of the base assembly. If your joiner does not have a removable baseplate, you'll need to drill holes through the baseplate.*

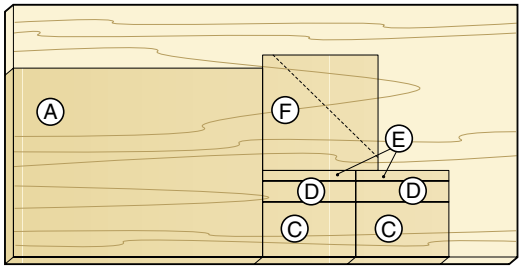
3 Finally, install a ¼-20×2¼" toilet bolt, ¼" flat washer, and four-arm knob on the alignment guide, where shown on **Drawing 1**. Then slide the guide onto the base assembly, engaging the toilet-bolt head in the T-groove, and tighten the knob. Now clamp the jig to your workbench, and plunge away!



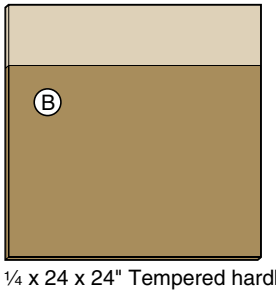


Position your biscuit joiner on the jig, and clamp it to the straightedge. Then mark the centerpoints of the joiner-base mounting holes (shown at *right*).

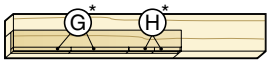
Cutting Diagram



¾ x 24 x 48" Birch plywood



¼ x 24 x 24" Tempered hardboard



¾ x 3½ x 24" Hardwood (.7 bd. ft.)
*Plane or resaw to the thickness listed in the Materials List.

Materials List

Base assembly	FINISHED SIZE T	W	L	Matl.	Qty
A base	¾"	18"	23¾"	BP	1
B* top	¼"	18"	23¾"	TH	1
C brackets	¾"	5¼"	8⅞"	BP	2
D fences	¾"	2"	8⅞"	BP	2
E cleats	¾"	1"	8⅞"	BP	2
90°/45° alignment guide					
F guide	¾"	11"	11"	BP	1
G* long guide bars	¼"	⅜"	5½"	H	2
H* short guide bars	¼"	⅜"	2¼"	H	2

*Parts initially cut oversize. See the instructions.

Materials key: BP–birch plywood, TH–tempered hardboard, H–hardwood.

Supplies: #8×1½" flathead wood screws (16), ¼–20×2¼" toilet bolt, ¼" flat washer, four-arm knob.

Blades and bits: Dado-blade set, flush-trim router bit, 1" Forstner bit.

Written by **Owen Duvall**
Project design: **Jeff Mertz**
Illustrations: **Roxanne LeMoine**

Better Homes and Gardens®
WOOD® PATTERNS®
February/March 2005 *Issue 161*

Dear Reader: As a service to you, we've included full-size patterns on this insert for irregular shape and intricate project parts. You can machine all other project parts using the Materials List and the drawings accompanying the project you're building.

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Closet Storage, Page 38
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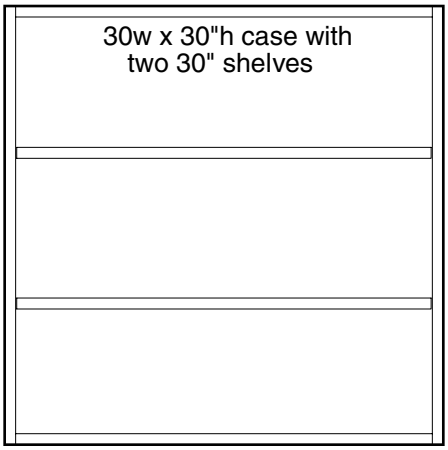
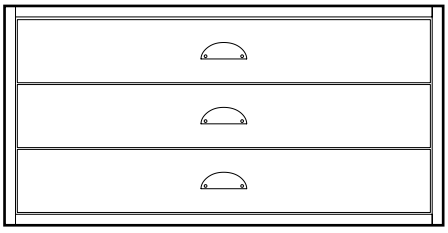
Blanket Chest, Page 64

Closet Storage, Page 38

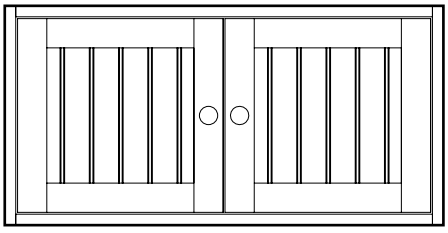
30w x 30"h case with two 30" shelves



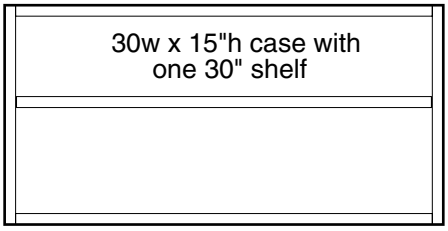
30w x 15"h case with three 30w x 5"h drawers



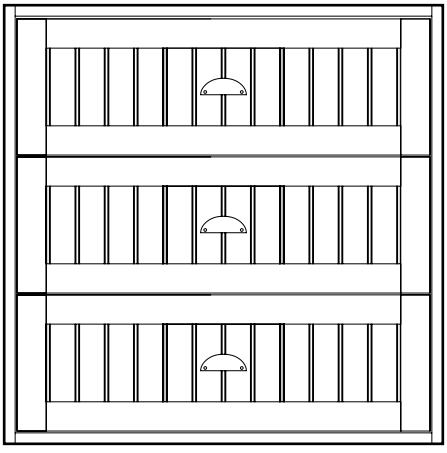
30w x 15"h case with two 15w x 15"h double doors



30w x 15"h case with one 30" shelf

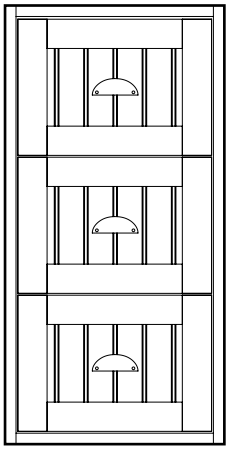


30w x 30"h case with three 30w x 10"h drawers



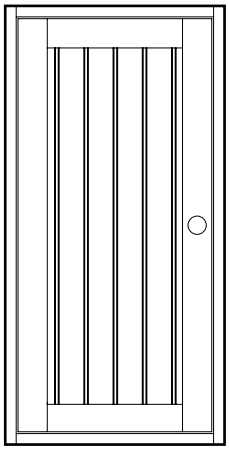
30" base

15w x 30"h case with three 15w x 10"h drawers

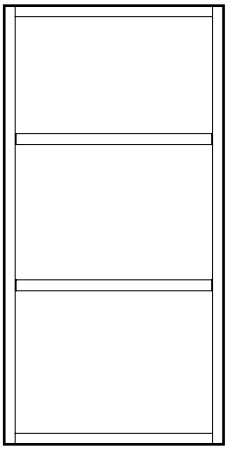


15" base

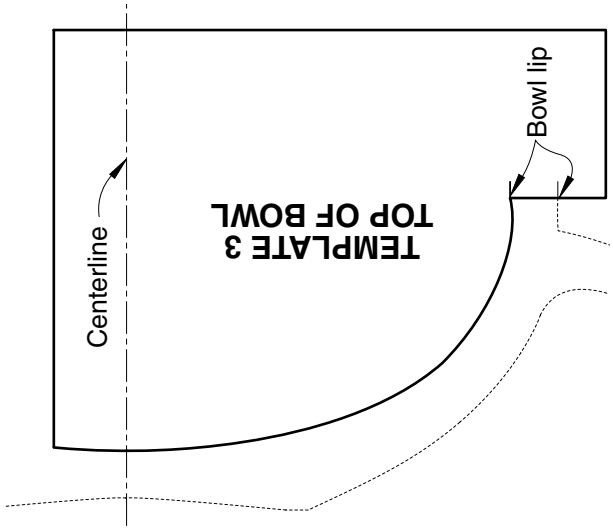
15w x 30"h case with one 15w x 30"h door



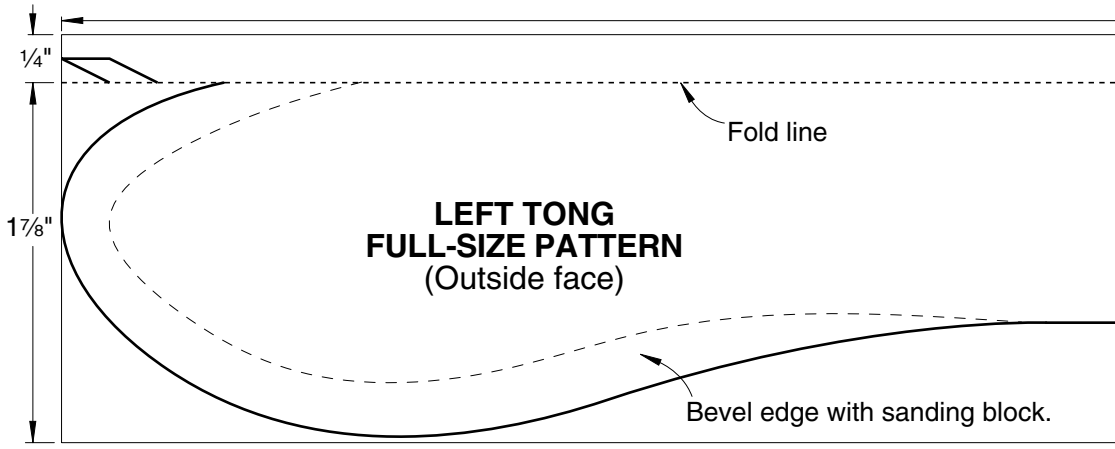
15w x 30"h case with two 15" shelves

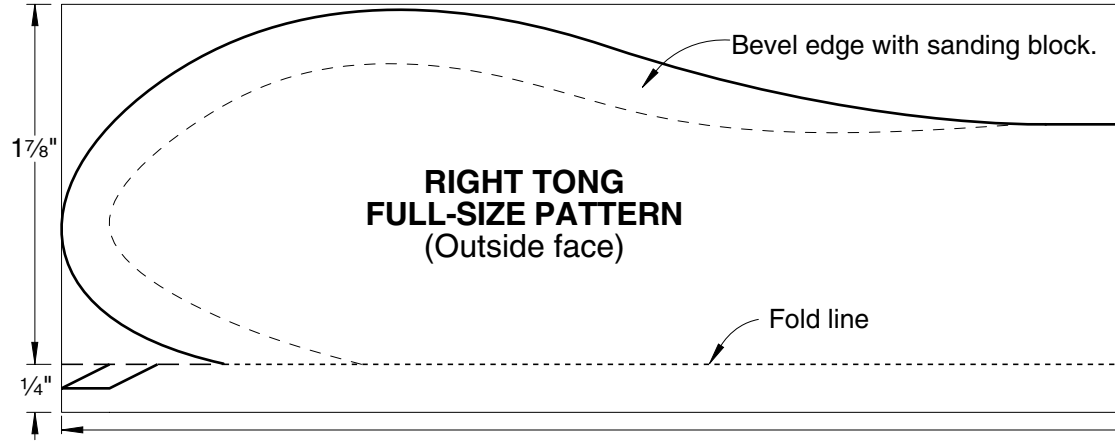


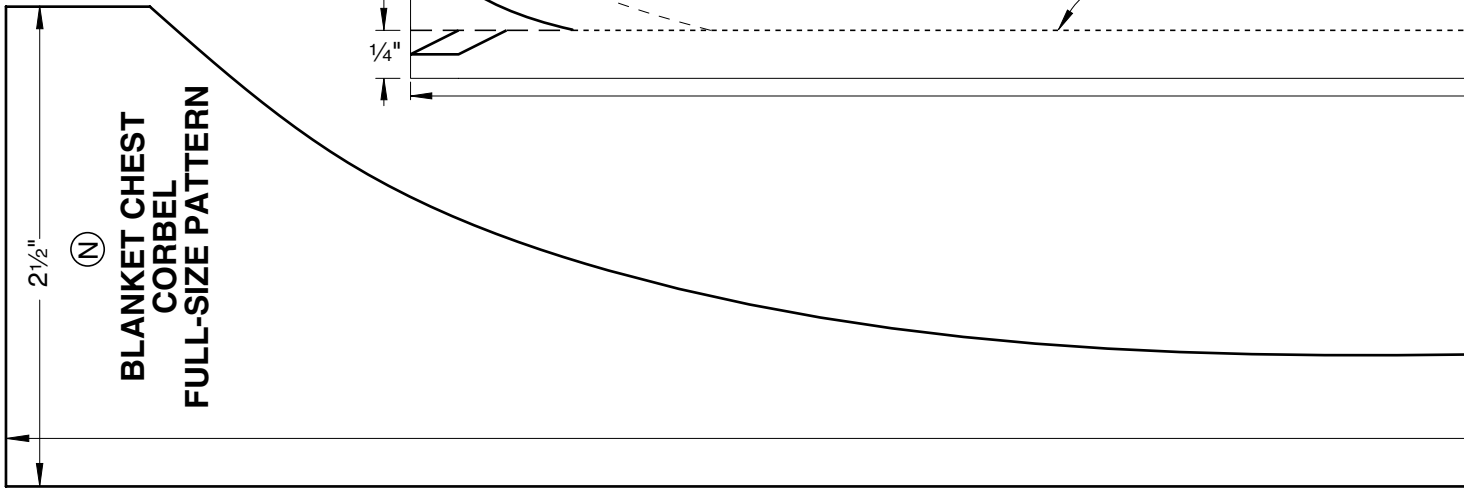
Wavy Bowl, Page 60

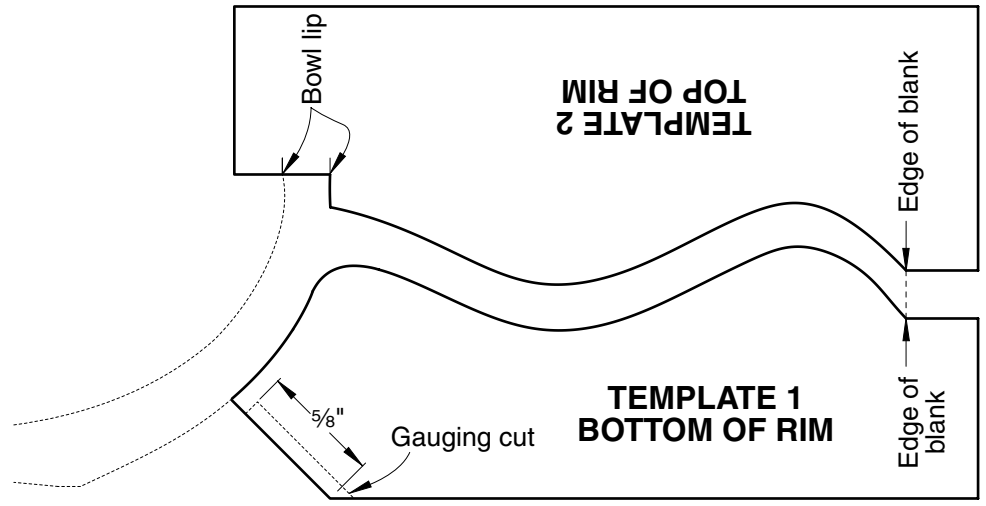


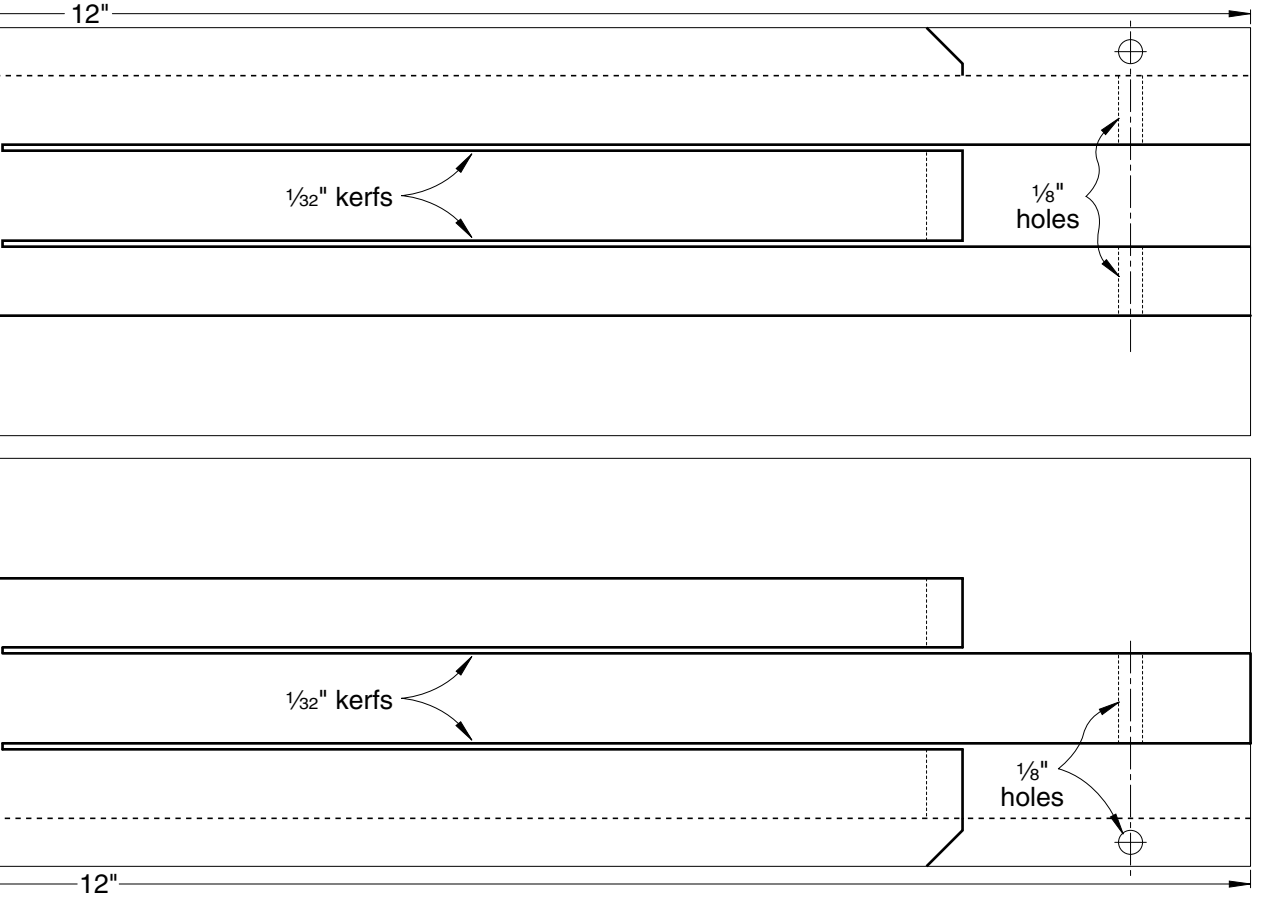
Salad Tongs, Page 28



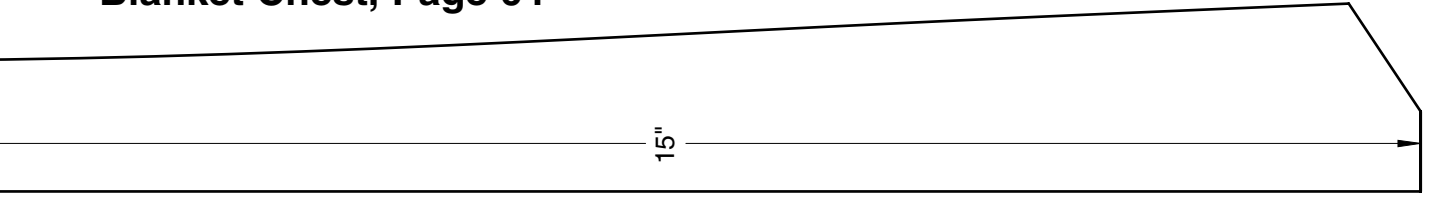


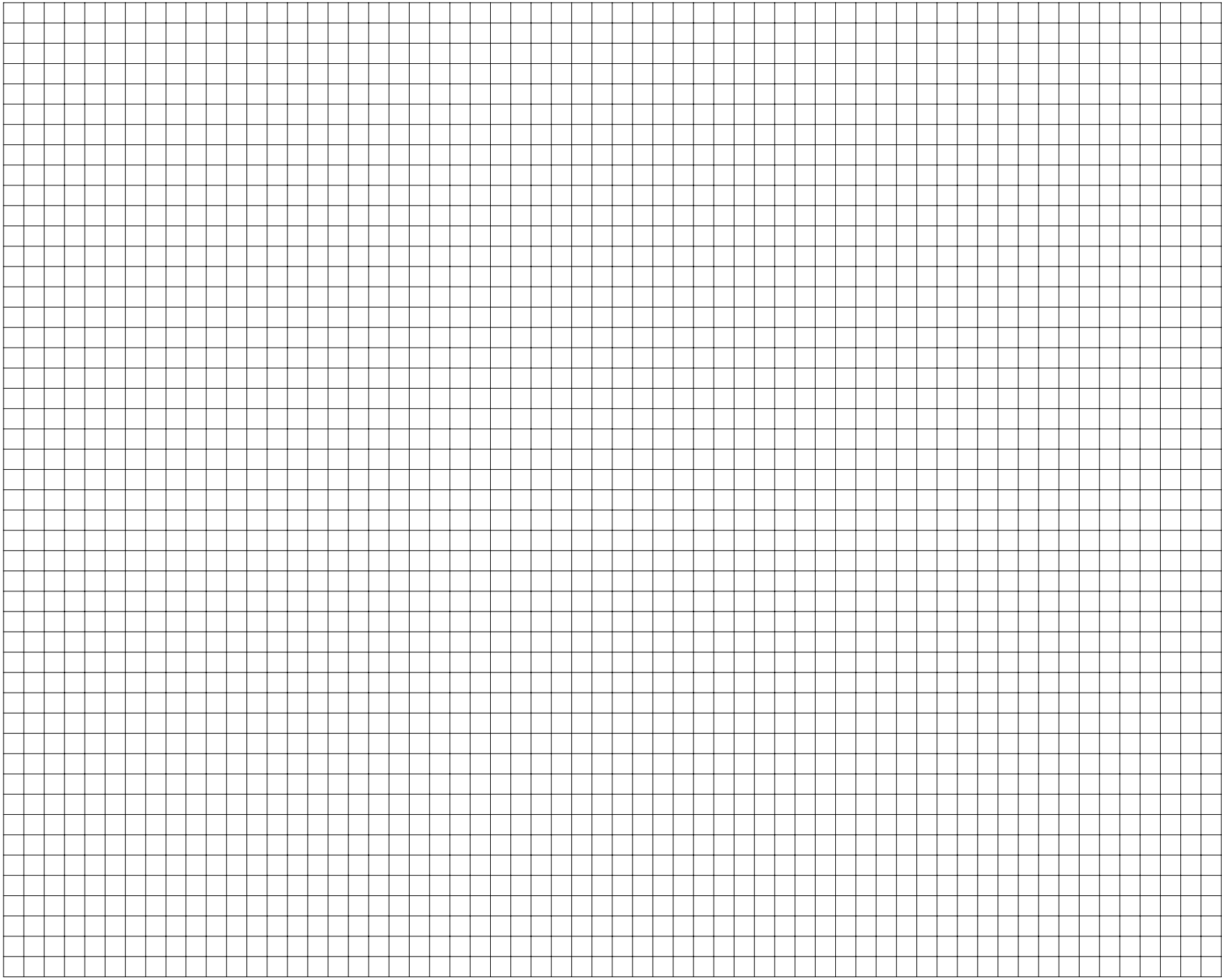






Blanket Chest, Page 64





8 x 10' Grid

One square equals 2"

discover the turning secrets of this

square-edged bowl

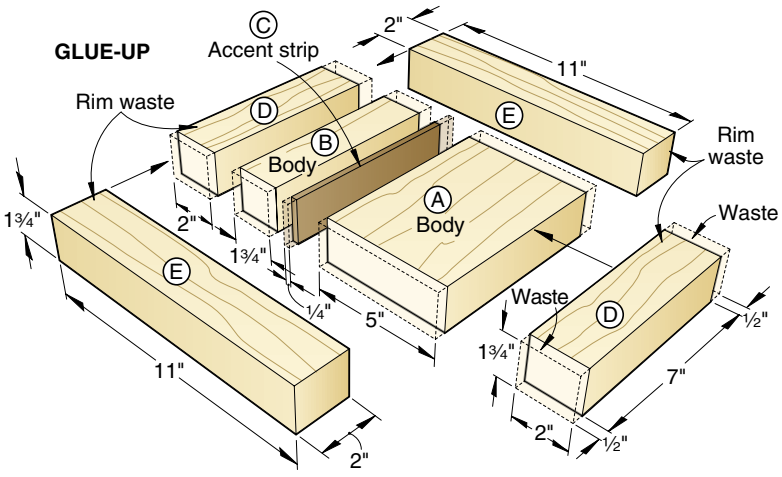
With square corners and a wavy rim, this bowl will have admirers thinking you're a woodturning wizard, and for good reason. Only you'll know that adding some waste material when gluing up the blank makes it as easy (and safe) to turn as a round plate.

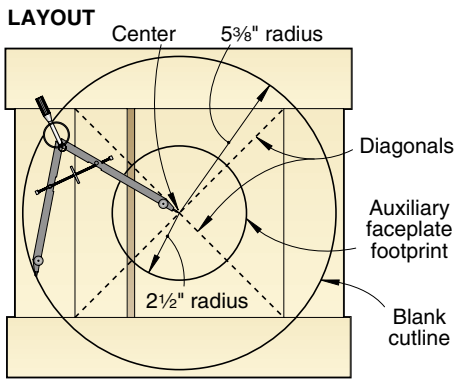
Try to turn an object from a square blank, and you'll have to contend with sharp corners whizzing around at high speed and the difficulty of "turning air" as the gaps between the blank corners rotate past the tip of your lathe tool. You'd also have trouble sanding the piece. In this project, professional turner Vic Wood shows how to eliminate these problems. We sized this bowl for a 14"-swing lathe. If necessary, adjust the diameter of the blank to allow your tool-rest base to pass between it and the lathe bed.

1 Make the laminated blank

Referring to the drawing *below*, glue up the turning blank. (We used maple for the body, wenge for the accent strip, and scrap softwood for the rim waste.) Start by edge-joining the 8"-long body parts (A, B), accent strip (C), and rim waste (D), keeping the top and bottom surfaces flush. With the glue dry, cut the assembly to 7" long, trimming both ends. Now glue the rim waste (E) in place with the edges and ends flush.

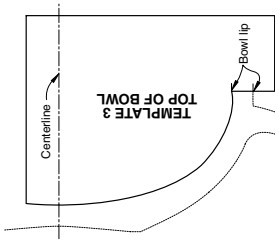
Referring to the drawing *below right*, draw diagonals to find the center and draw the auxiliary faceplate footprint and blank cutline. Bandsaw the blank to form a 10¾"-diameter disc. Then cut a 5"-diameter auxiliary faceplate from 1¾"-thick poplar scrap, and glue it to the turning blank, centered in the footprint circle. Finally, center a 3" face plate on the waste block, screw it in place, and mount the blank on your lathe.

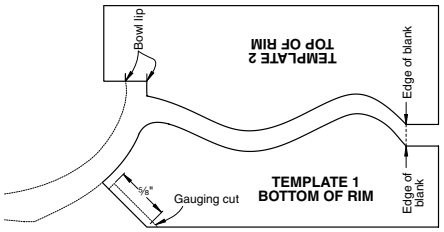


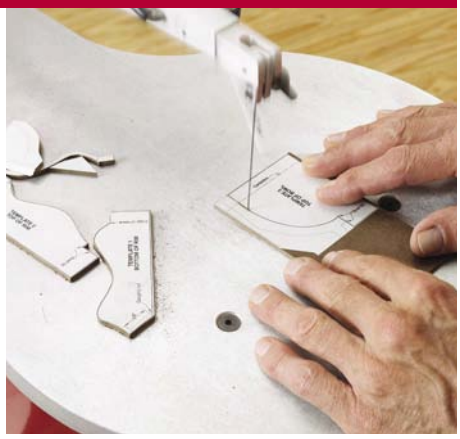


2 Create the templates

Copy the three templates on the *WOOD Patterns*® insert, and adhere them with spray adhesive to ⅛" tempered hardboard. Scrollsaw the templates to shape, as shown at *right*.



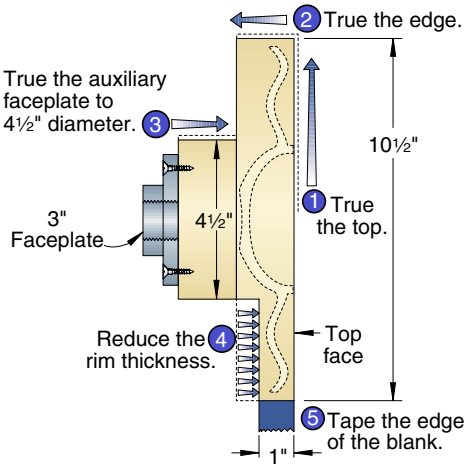




3 True the surfaces

Tool: ⅜" bowl gouge.
Tool rest: Slightly below center.
Speed: 600–800 rpm.

True the top of the blank with your bowl gouge. The blank should be fairly flat already, so take off as little as needed. True the outside edge, turning the blank to a 10½" diameter. Then true the auxiliary faceplate to a 4½" diameter. This gives you the maximum amount of room to form the bottom profile and preserves enough of the waste block for later use as a jam chuck. Now mark a line on the edge of the blank 1" from the top face. Remove material from the bottom of the blank to this line, working in from the edge to the auxiliary faceplate diameter. To reinforce the blank edge, wrap it with a couple layers of masking tape.

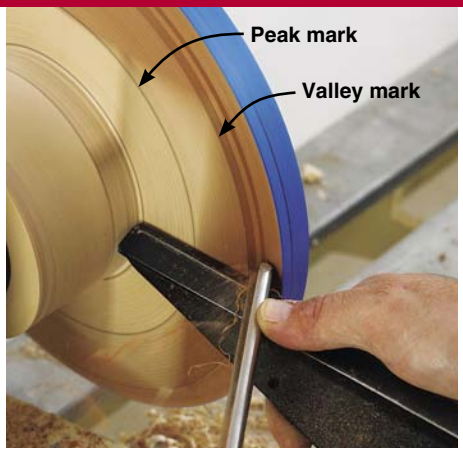


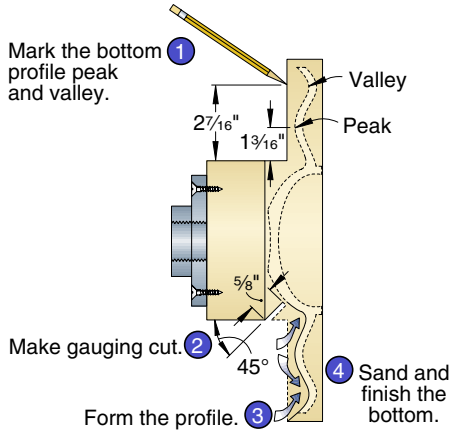
4 Form the bottom profile

Tools: Parting tool, ¼" bowl gouge, ½" round-nose scraper.
Tool rest: Parting tool, at center; gouge, slightly below center; round-nose scraper, slightly above center.
Speeds: Tools, 1,200–1,600 rpm; sanding, buffing finish, 800–1,200 rpm.

Measuring from the edge of the auxiliary faceplate, mark peak and valley centers on the bottom of the rim. Then use your parting tool to make a ⅝"-deep gauging cut that enters the blank at the glue line between the auxiliary faceplate and the blank at a 45° angle. Now use your bowl gouge to form the bottom profile, as shown at *right*. Check your progress with **Template 1**. To form a smooth transition where the rim and bowl bottom meet, use a round-nose scraper.

Remove the tool rest, slow the lathe, and finish-sand the bottom. For best results, increase sanding grits by no more than 50 percent at each step. Start with 120-grit sandpaper and progress through at least 500 grit. For a super-smooth finish, progress all the way to 2500 grit. Apply a clear finish of your choice. (We applied semigloss lacquer with a foam brush, turning the blank by hand. Then, switching on the lathe, we buffed the still-wet finish with a paper towel. Heat from buffing friction causes the finish to dry immediately.)





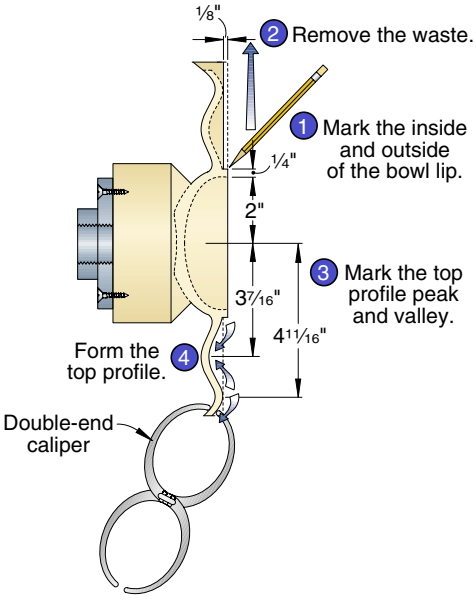
Caution! *Always use paper towels when buffing a workpiece on a spinning lathe. If the paper towel should catch, it will tear, and avoid possible injury to your hand.*

5 Form the top profiles

Tool: ⅜" bowl gouge.
Tool rest: Slightly below center.
Speeds: Gouge, 1,200–1,600 rpm; sanding, 800–1,200 rpm.

Mark the inside and outside of the bowl lip. Use your bowl gouge to remove ⅛" from the outside lip mark to the edge of the blank, as shown *above*. Then mark the peak and valley centers. Now use your bowl gouge to form the top profile, as shown *above*, checking your progress with **Template 2**. Check the rim for a uniform ¼" thickness with a double-end caliper.

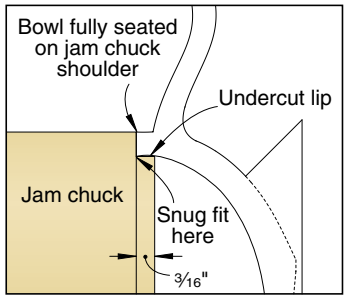
Note: *The top profile must parallel the bottom profile. When marking the top peak and valley, make sure they align with the bottom valley and peak.*

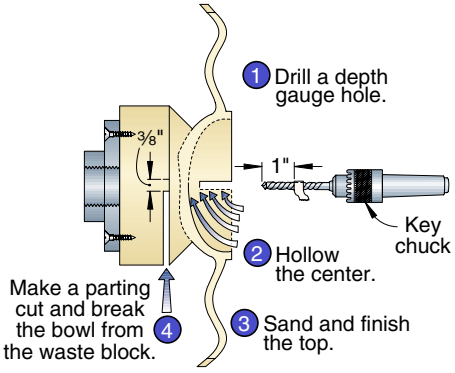


6 Hollow the center and part the bowl

Tools: 5/16" drill bit, ⅜" bowl gouge, ½" round-nose scraper, parting tool.
Tool rest: Gouge, slightly below center; scraper, slightly above center; parting tool, at center.
Speeds: Drill, 800 rpm; gouge and scraper, 1,200–1,600 rpm; sanding, 800–1,200 rpm; parting tool, 800 rpm.

To provide a depth gauge for hollowing the inside of the bowl, remove the tailstock center and install a key chuck and a 5/16" bit. Mark a 1" depth on the bit with masking tape. With the lathe running, feed the bit into the bowl blank to the marked depth. Now back off the tail stock, and use your bowl gouge to hollow the bowl. Making a series of shallow cuts toward the center, work outward from center to lip, as shown in the photo at *right*. Smooth the interior with a round-nose scraper. For reverse-chucking the bowl on a jam chuck later, slightly undercut the inside of the bowl lip, as shown on the drawing at *top right*. With the profile complete, slow the lathe, finish-sand the top, and apply a clear finish. Adjust the lathe speed to 800 rpm and make a parting cut to a ⅜" diameter just to the waste side of the glue line between the auxiliary faceplate and the bowl blank. Stop the lathe and carefully saw the bowl blank from the auxiliary faceplate.



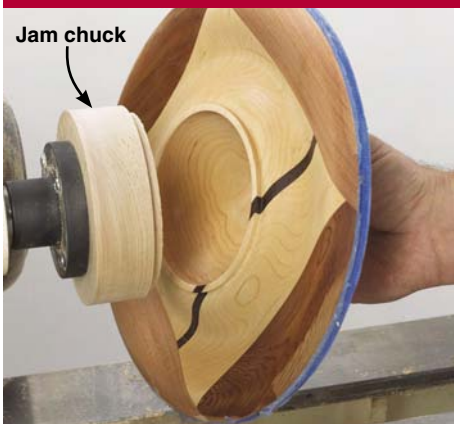

1 Drill a depth gauge hole.
⅜"
1"
Key chuck
2 Hollow the center.
Make a parting cut and break the bowl from the waste block. 4
3 Sand and finish the top.

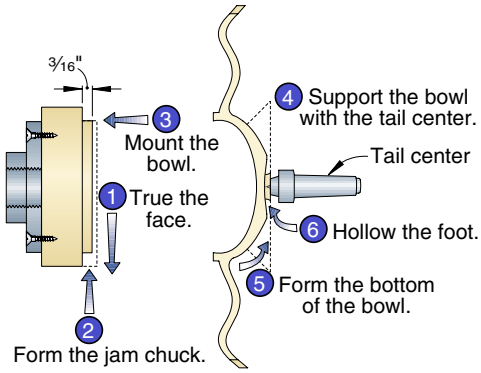
Meet our expert

Internationally known Australian woodturning icon Vic Wood, at *right*, has qualifications in cabinetmaking, woodturning, goldsmithing, and silversmithing. Turning full time since 1983, Vic has traveled to England, Canada, the U.S., New Zealand, and throughout Australia teaching and demonstrating woodturning.

Vic gained his early reputation from turned and carved wall plaques. Square-edged lidded boxes have become his signature pieces. Vic's woodturning artistry is highly sought after with his works appearing in private and public collections and galleries throughout the world. To view Vic's work, go to ubeaut.com.au/vicwood.html

7 Reverse-chuck the bowl and finish the bottom




3/16"
3 Mount the bowl.
1 True the face.
2 Form the jam chuck.
4 Support the bowl with the tail center.
Tail center
6 Hollow the foot.
5 Form the bottom of the bowl.

Tool: ⅜" bowl gouge, parting tool.
Tool rest: Gouge, slightly below center; parting tool, at center.
Speed: 1,200–1,600 rpm.

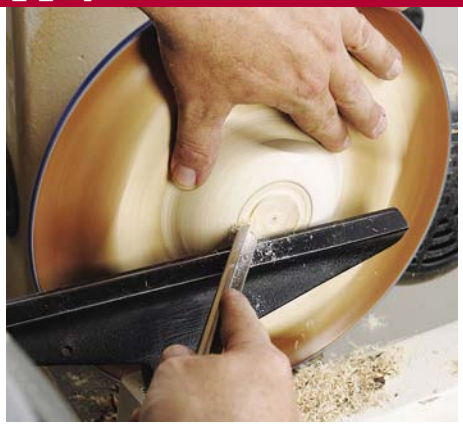
To make a jam chuck from the auxiliary faceplate, leave it mounted and use your bowl gouge to true the face. Then use your parting tool to form a square-edged 3/16-long spigot on the end. Sneak up on the spigot diameter, testing the bowl on it for a snug fit. Make sure the bowl lip seats flat on the jam chuck shoulder. Mount the bowl on the jam chuck, as shown *above left*, and support it with the tail center. Mark the foot diameter and use your bowl gouge to form the bottom of the bowl, as shown *above*.

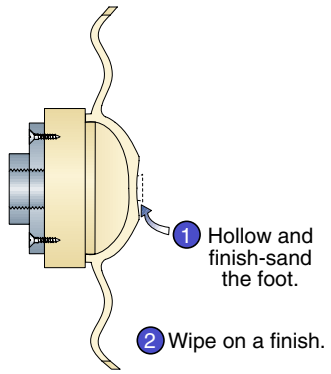
Note: *To improve the grip of the jam chuck, apply chalk to the spigot, or wet it with hot water. If you remove too much material from the auxiliary faceplate, causing the bowl to fit loosely, insert up to four layers of tissue paper. If the fit is still too loose, cut a new spigot.*

8 Hollow the foot and apply a finish

Tool: ⅜" bowl gouge.
Tool rest: Slightly below center.
Speed: 800–1,200 rpm.

Back off the tail stock, and use your bowl gouge to form a slight hollow in the foot. Apply light pressure to the bowl with one hand, as shown at *right*. Finish-sand and finish the bottom of the bowl. Remove it from the lathe.





9 Trim the waste from the rim

Jigsaw a hole in a piece of ½" or ¾" plywood scrap to loosely fit the outside diameter of the bowl lip. Adhere the bowl to the scrap with double-faced tape, as shown *above*.

Bandsaw the rim waste just to the waste side of the glue line, as shown *above*. Sand the remaining waste and glue from the edges, and finish them.

Source

Bowl blank. Maple, wenge, and softwood parts A, B, C, and D, glued, sanded, and trimmed to 7", as shown on *page 60*, plus two softwood parts E and a piece of 1¾"-thick poplar stock for the auxiliary faceplate. Order kit no. W-161B, and indicate one of the following quantities: one kit $24.95 ppd., or five kits, $89.85 ppd. Heritage Building Specialties. Call 800/524-4184, or go to heritagewood.com.

New to woodturning or looking for more turned project ideas? Visit the WOOD Online woodturning forum at woodmagazine.com/turning. Post questions on this project or any turning technique. Phil Brennion, our turning expert, monitors this forum, and he and other turners will be happy to assist you. To see more woodturning projects, go to woodmagazine.com/turnedprojects

forever-cherished blanket chest

Give your comforters, blankets, and pillows a stylishly handsome home with this heirloom-quality Arts & Crafts storage project.

Whether you've eagerly waited for this design—the perfect companion to the Arts & Crafts bed featured in the October 2004 issue—or simply need a stand-alone blanket chest plan, we've got you covered. You'll admire this beauty's clean lines, gently curved rails, classic corbels, and eye-catching quartersawn white oak figure. Plus you'll appreciate the simple construction, centered around straightforward stub-tenon-and-groove joinery for the side and front/back assemblies. In case you missed the other matching pieces of our latest bedroom set, you'll find the plans for a dresser and mirror in the previous issue, and the night-stand in the November 2004 issue. Or you can obtain the plans at woodmagazine.com/mission.

Bedding items stay protected and handy in this roomy chest. Special supports keep the lid from slamming shut and pinching fingers.

AT A GLANCE

- Overall dimensions are 45" wide × 21½" deep × 20½" high.
- For the board feet of lumber and other items needed to build this project, see *page 68*.

Note: *The side and front/back assemblies have parts with the same size grooves and tenons. To reduce setup changes, you can cut parts A, B, C, D, G, H, I, and M to size, and then machine the common features on the parts. You also can cut side panels E and front/back panels J to size and prestain them at the same time for efficiency and a more even stain application over the project.*

Let's start with the side assemblies

1 From ¾" stock, cut the legs (A), top rails (B), bottom rails (C), and stiles (D) to the sizes listed in the **Materials List**. Save the rail cutoffs to make test tenons.

2 Using a dado blade in your tablesaw, cut a centered ¼" groove 5/16" deep along the *inside* edges of the legs (A), the *bottom* edge of the top rails (B), the *top* edge of the bottom rails (C), and *both* edges of the stiles (D), where shown on **Drawing 1**.

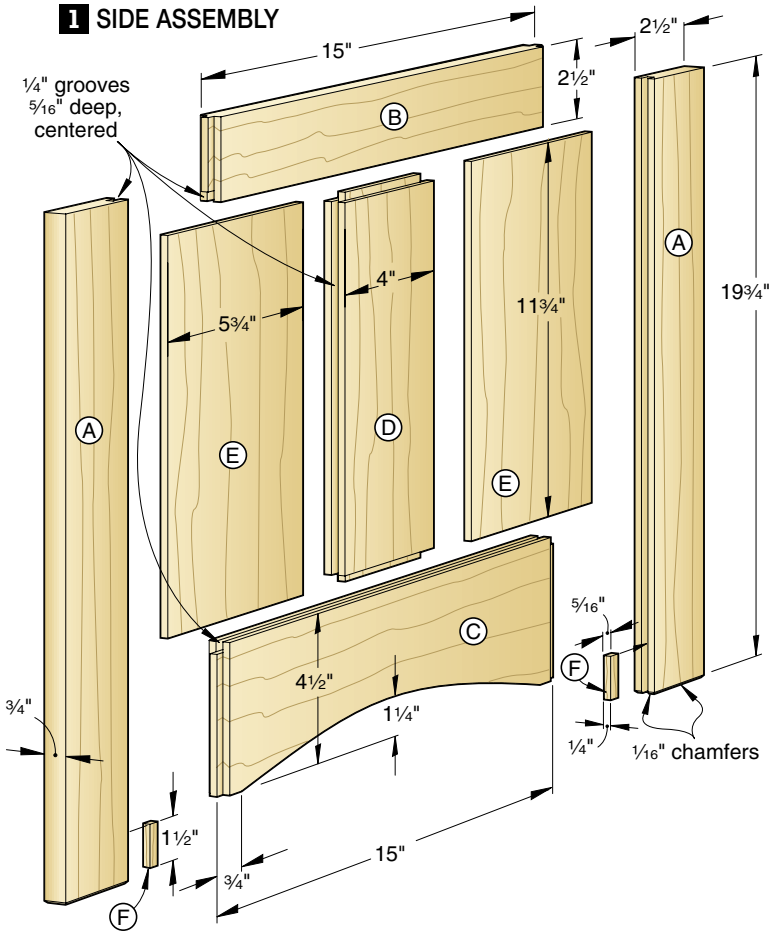
3 To form tenons on the top and bottom rails (B, C) and stiles (D), where shown on **Drawings 1** and **2**, attach an auxiliary fence to your tablesaw rip fence and an auxiliary extension to the miter gauge. Then cut a ¼" tenon ¼" long on the end of a rail cutoff. Test-fit the tenon in the groove of a leg. Adjust your setup, if needed, and cut the tenons on the rails and stiles.

4 Mark the ends and center of the arches on the bottom rails (C), where dimensioned on **Drawing 1**. Bending a fairing stick to these points, draw the arches. Then bandsaw and sand them to the marked lines. (For a free fairing stick plan, go to woodmagazine.com/fairing.)

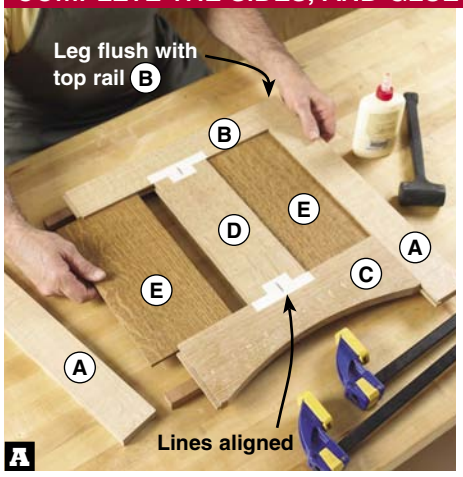
5 To form the side panels (E), resaw and plane ¾" stock to ¼" to fit the grooves in the legs, rails, and stiles. Then cut the panels to size. Sand the panels to 220 grit, and remove the dust. Then stain both faces. (We used Watco Danish Oil Finish, Dark Walnut, on the panels and chest.)

6 To center the stiles (D) with the top and bottom rails (B, C), mark alignment lines centered on the parts on masking tape. Glue and clamp the rails and stiles together, aligning the lines. After the glue dries, add the panels (E) and legs (A) to complete each side assembly, as shown in **Photo A**. (We did not glue the panels in place to allow for wood movement.) Sand the unstained portions of the assemblies smooth.

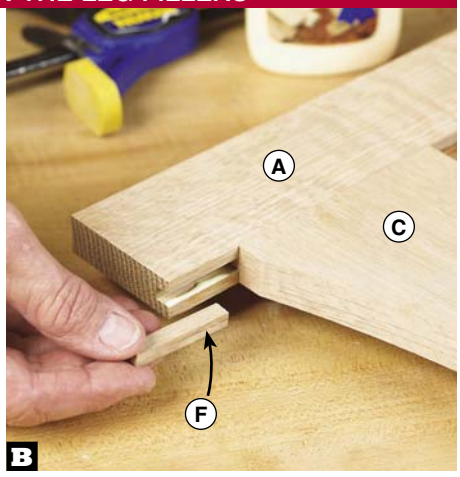
1 SIDE ASSEMBLY



COMPLETE THE SIDES, AND GLUE IN THE LEG FILLERS



Slide the stained panels (E) into the rail/stile assembly (B/C/D). Then glue and clamp the legs (A) in place, flush with the top rail (B).

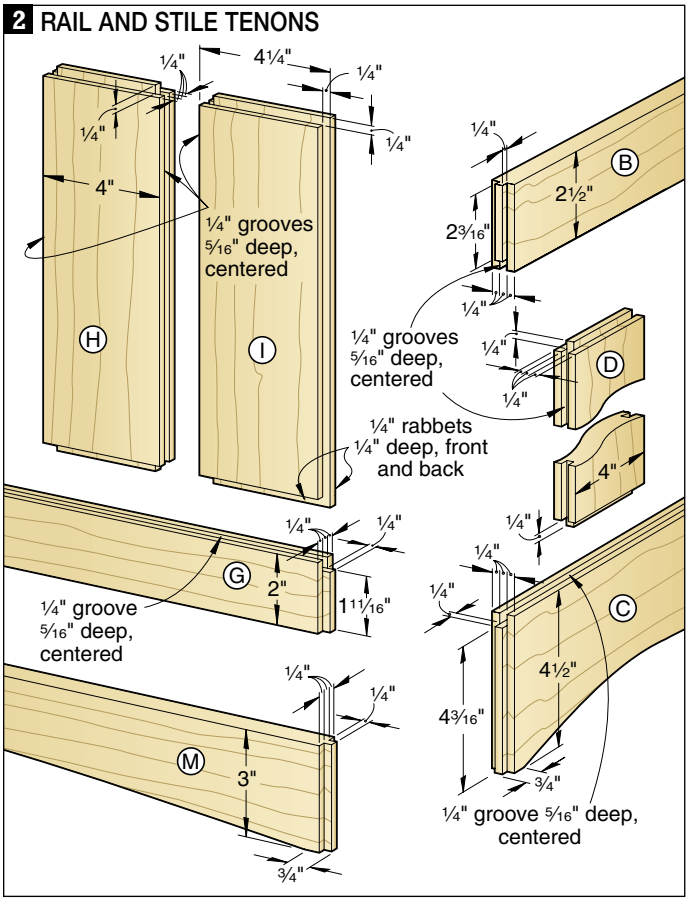


Apply glue in the groove in the leg (A). Insert a filler (F) in the groove tight against the bottom rail (C), and clamp it in place.

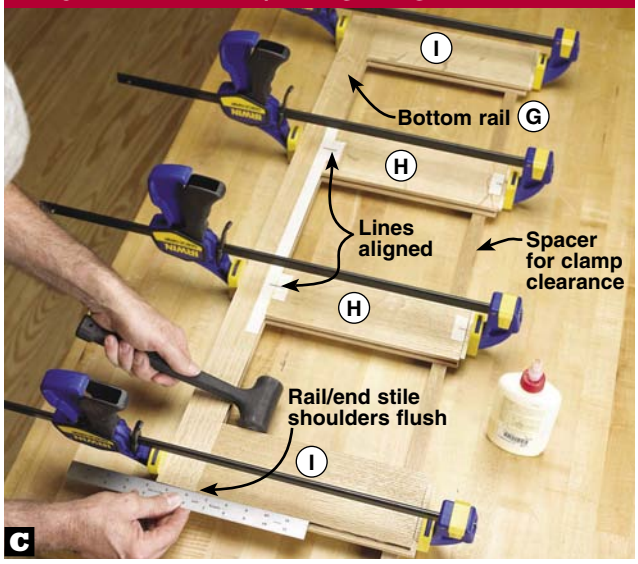
7 To make the leg fillers (F), plane a ¾×2×16" piece of stock to ¼" thick. Rip a 5/16"-wide strip from the piece. Then crosscut eight 1¾"-long fillers from the strip. Glue a filler in the bottom of the groove in each leg (A), as shown in **Photo B**. Let the glue dry overnight. Using a fine-tooth saw, trim the fillers flush with the bottoms of the legs, and sand smooth. Now sand chamfers on the bottom of the legs (A), where shown on **Drawing 1**. Set the remaining fillers aside.

8 Using a dado blade in your tablesaw, cut a ¼" groove 5/16" deep along the *inside* face of both side assembly legs (A), where dimensioned on **Drawing 3** on *page 66*. Then switch to a ¾" dado blade that matches the thickness of your plywood for the bottom panel (K). Now cut a ¼"-deep dado across the assemblies, where dimensioned.

2 RAIL AND STILE TENONS

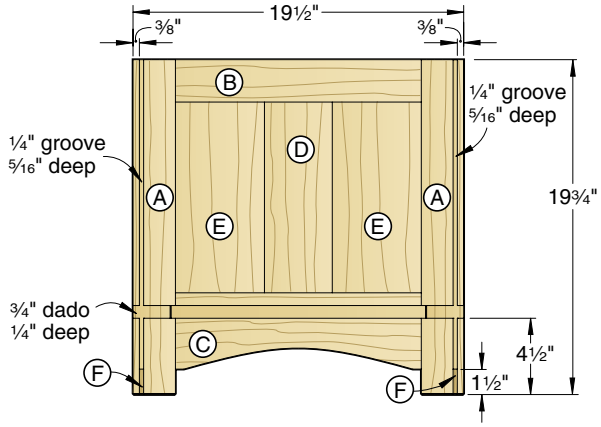


ALIGN THE MIDDLE/END STILES



Align the lines on the middle stiles (H) and bottom rail (G). Keep the tenon/tongue shoulders on the rail and end stiles (I) flush.

3 SIDE ASSEMBLY (Inside face shown)



Now make the front/back assemblies

1 Cut the top/bottom rails (G), middle stiles (H), and end stiles (I) to size.

2 As you did for the side assemblies, cut a centered ¼" groove 5/16" deep along the *inside* edges of the top/bottom rails (G) and end stiles (I) and along both edges of the middle stiles (H), where shown on **Drawings 2** and **4**. Then form ¼" tenons ¼" long on the rails and stiles, where shown, to fit the grooves in the legs (A) and rails (G). Using the same tablesaw setup, rabbet the *outside* edges of the end stiles (I) on both faces to form ¼" tongues ¼" long to fit the grooves in the legs (A).

3 From ¾" stock resawn and planed to ¼", cut the front/back panels (J) to size. Sand and stain the panels.

4 To align the middle stiles (H) with the top/bottom rails (G), mark the centers of the stiles at the tops and bottoms on masking tape. Then mark alignment lines on the rails 13" from the tenon shoulders at the ends, where dimensioned on **Drawing 4**. Glue and clamp two middle stiles and two end stiles (I) to each bottom rail, aligning the stiles as shown in **Photo C**. After the glue dries, slide the front/back panels (J) in place. Now glue and clamp the top rails to the assemblies, verifying correct stile alignment. Sand the assemblies smooth.

Time for the bottom panel and bottom rails

1 From ¾" oak plywood, cut the bottom panel (K) to size. Then, from ¾" stock, cut the trim (L) to size.

2 Glue and clamp the trim, centered, on the front and back edges of the panel. After the glue dries, sand the trim flush with the panel. Rout 1/16" chamfers along the top and bottom edges of the trim, where shown on **Drawing 4**. Then hand-sand chamfers on the ends of the trim.

3 Cut the bottom rails (M) to size. Form ¼" tenons ¼" long on the rails, where shown on **Drawing 2**. Then mark the ends and center of the arches, where dimensioned on **Drawing 4**, and draw the curves. Bandsaw and sand the arches to shape.

Let's put together what you've made so far

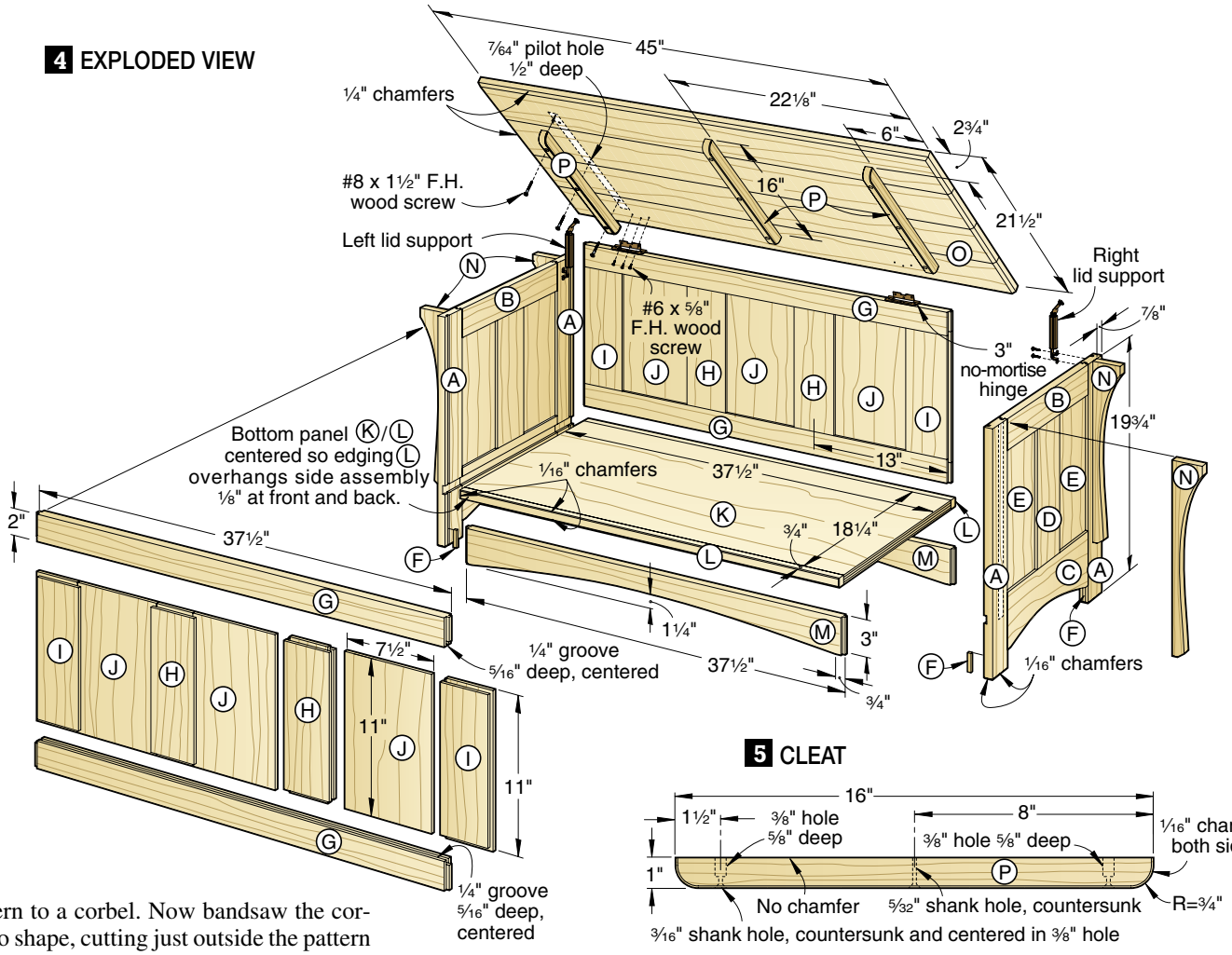
1 Position a side assembly (A through F) with the *inside* face up on scrap 4×4s placed across sawhorses, as shown in **Photo D**. (This gives clearance for clamps.) Then glue and clamp the front/back assemblies (G/H/I/J) in place, as shown, keeping the top edges of the assemblies flush.

2 When the glue dries, apply glue to the bottom edges of the front/back assembly bottom rails (G) and in the dado in the side assembly. Now clamp the bottom panel (K/L) in position, as shown in **Photo E**, centering it so the edging (L) overhangs the front and back of the side assemblies ⅛". Later, glue and clamp the bottom rails (M) and the remaining side assembly in place.

3 Glue and clamp the remaining four fillers (F) in the bottom of the grooves in each leg (A), where shown on **Drawing 4**, tight against the bottom rails (M). As before, let the glue dry overnight. Then flush-trim and sand the fillers smooth.

4 Cut the corbels (N) to size. Photocopy the full-size corbel pattern from the *WOOD Patterns*® insert. Spray-adhere the

4 EXPLODED VIEW



5 CLEAT

pattern to a corbel. Now bandsaw the corbel to shape, cutting just outside the pattern line. Sand to the line with a 120-grit sanding drum. Using this piece as a template, mark the contour on the other three corbels. Cut and sand them to shape.

5 Apply glue to the back edges of the corbels. Then clamp them in place on the legs (A) flush with the top ends and 7/8" from the outside edges, where dimensioned on **Drawing 4**.

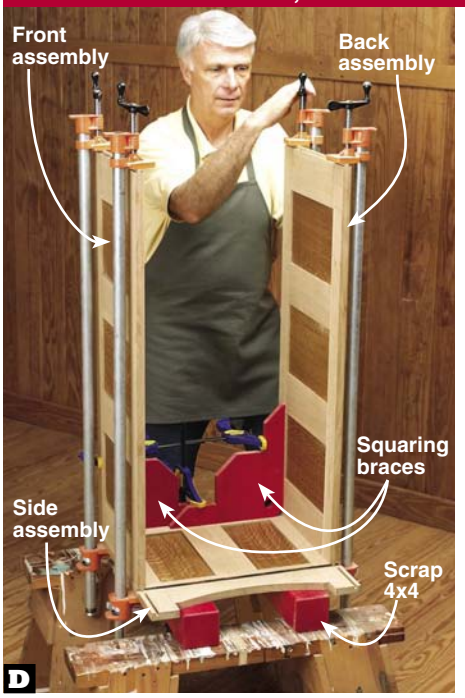
Top off the chest by crafting a beautiful lid

1 Edge-join 3/4" stock to form a 22×45 1/2" workpiece for the lid (O). After the glue dries, crosscut and rip the lid to 21 1/2×45". Then rout a 1/4" chamfer along the bottom edges of the lid, where shown on **Drawing 4**. Sand the lid smooth.

2 Cut the cleats (P) to size. Mark 3/4" radii on the ends, where shown on **Drawing 5**. Bandsaw and sand the ends to shape. Then rout 1/16" chamfers along both edges of the cleats, where shown.

3 To allow for movement of the lid (O) with seasonal changes, drill centered 3/8" holes 5/8" deep in the nonradiused edge of the cleats at the ends, where dimensioned on **Drawing 5**. For easy drilling and consistent hole locations, clamp a stop-

FOR EASY ASSEMBLY, GLUE UP THE CHEST IN TWO STAGES



Clamp the front/back assemblies to the side assembly, using squaring braces to keep the overall assembly square.

Clamp the bottom panel (K/L) to the case assembly, adding the remaining side assembly (no glue) to aid alignment.

block to your drill-press fence. Next, drill 3/16" shank holes centered in the 3/8" holes through the cleats. Remove the stopblock. Now drill a 5/32" shank hole through the center of the cleats, where shown. With the nonradiused edge down, countersink all of the holes.

4 Place the lid bottomface up on your workbench. Position the cleats on the lid, where dimensioned on **Drawing 4**. Using the shank holes in the cleats as guides, drill 7/64" pilot holes 1/2" deep in the lid. Then drive the screws.

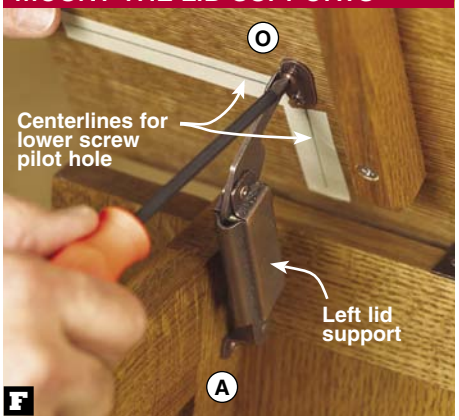
Add the stain and finish, and mount the lid

1 Finish-sand any areas that need it, and remove the dust. Apply stain. After the stain dries, top-coat with a clear finish. (We applied three coats of Aquazar Water-Based Clear Satin Polyurethane, sanding to 320 grit between coats.)

2 Position 3" no-mortise hinges flush with the inside edge of the back top rail (G), where dimensioned on **Drawing 6**. Drill the mounting holes, and drive the screws supplied with the hinges.

3 To attach the lid (O/P) to the chest, apply two layers of cloth-backed double-faced tape to the lid side of the small hinge leaves. Position the lid on the chest, centering it front-to-back and side-to-side. Press firmly on the lid to adhere the taped hinge leaves. Using a helper to support the lid, carefully open it, and drill the hinge mounting holes. Remove the lid and tape, and screw the hinges to the lid.

MOUNT THE LID SUPPORTS



With the lid support top mounting bracket aligned with the pilot holes in the lid, drive the screws. Then remove the masking tape.

4 To install the left and right lid supports, mark centerlines for mounting the supports to the inside face of the legs (A) and the lid (O) on masking tape, where dimensioned on **Drawing 6**. Align the upper holes in the support bottom mounting brackets with the marked centerlines on the legs. Drill pilot holes, screw the brackets in place, and remove the tape.

5 Finally, angle the lid to align the lower holes in the support top mounting brackets with the marked centerlines on the lid. Drill pilot holes, and attach the brackets, as shown in **Photo F**. Now round up your bed coverings, and place them in their beautiful new abode.

Written by **Owen Duvall** with **Chuck Hedlund**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine**

Materials List

		FINISHED SIZE T	W	L	Matl.	Qty.
Side assemblies						
A	legs	3/4"	2 1/2"	19 3/4"	QO	4
B	top rails	3/4"	2 1/2"	15"	QO	2
C	bottom rails	3/4"	4 1/2"	15"	QO	2
D	stiles	3/4"	4"	11 3/4"	QO	2
E	side panels	1/4"	5 3/4"	11 3/4"	QO	4
F*	leg fillers	1/4"	5/16"	1 1/2"	QO	8
Front/back assemblies						
G	top/bottom rails	3/4"	2"	37 1/2"	QO	4
H	middle stiles	3/4"	4"	11"	QO	4
I	end stiles	3/4"	4 1/4"	11"	QO	4
J	front/back panels	1/4"	7 1/2"	11"	QO	6
Bottom panel, bottom rails, and corbels						
K	bottom panel	3/4"	18 1/4"	37 1/2"	OP	1
L	trim	3/4"	3/4"	37 1/2"	QO	2
M	bottom rails	3/4"	3"	37 1/2"	QO	2
N	corbels	3/4"	2 1/2"	15"	QO	4
Lid assembly						
O*	lid	3/4"	21 1/2"	45"	EQO	1
P	cleats	3/4"	1"	16"	QO	3

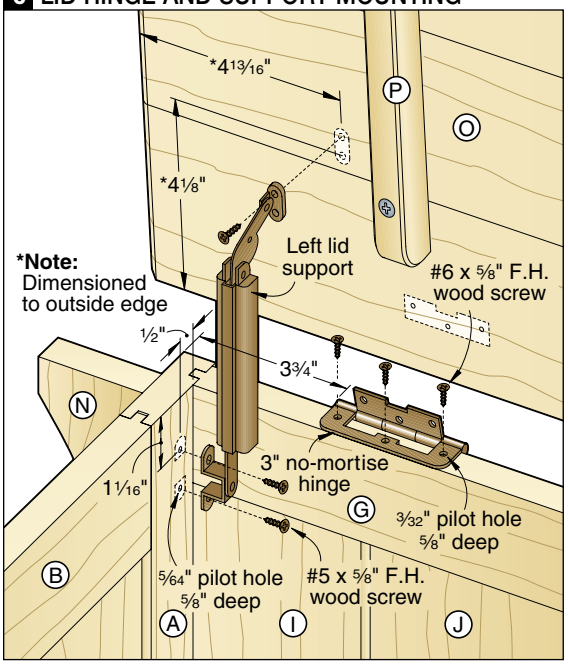
*Parts initially cut oversize. See the instructions.

Materials key: QO–quartersawn white oak, OP–oak plywood, EQO–edge-joined quartersawn white oak.
Supplies: Cloth-backed double-faced tape, spray adhesive, #5x5/8" flathead wood screws (8), and #8x1 1/2" flathead wood screws (9).
Blades and bits: Dado-blade set, 45° chamfer router bit.

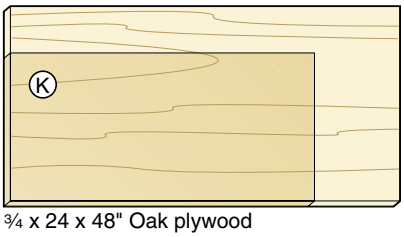
Sources

Hardware. Right lid support no. 26237 and left lid support no. 26203, $3.99 ea.; 3" no-mortise hinges no. 28704, $2.99 pr. (1 pr.). Call Rockler, 800/279-4441; rockler.com.

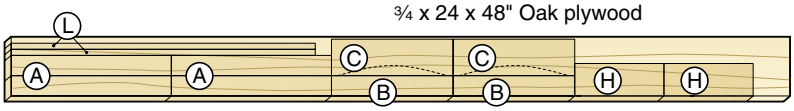
6 LID HINGE AND SUPPORT MOUNTING



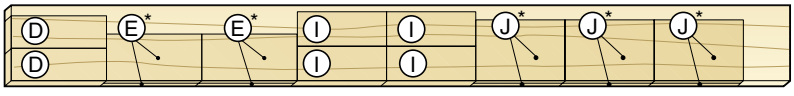
Cutting Diagram



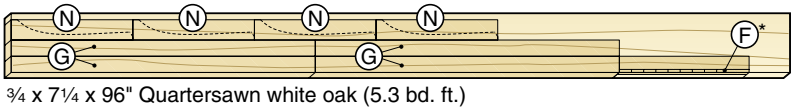
3/4 x 24 x 48" Oak plywood



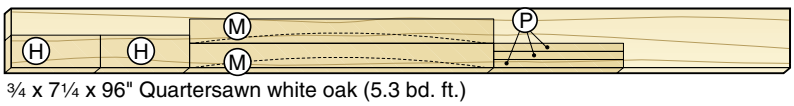
3/4 x 7 1/4 x 96" Quartersawn white oak (5.3 bd. ft.)
*Resaw and plane to the thickness listed in the Materials List.



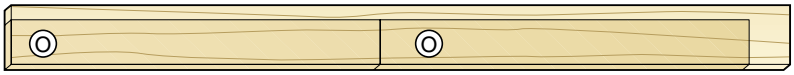
3/4 x 9 1/4 x 96" Quartersawn white oak (6.7 bd. ft.)



3/4 x 7 1/4 x 96" Quartersawn white oak (5.3 bd. ft.)



3/4 x 7 1/4 x 96" Quartersawn white oak (5.3 bd. ft.)



3/4 x 7 1/4 x 96" Quartersawn white oak (5.3 bd. ft.) (2 needed)

SHOP-TESTED

14.4-volt drills

These tools finesse tiny brass screws into place, muscle big lag screws into lumber, and churn drill bits through the hardest woods.

Although 12-volt cordless drills have enough power for most woodworking tasks, it's difficult to resist the lure of the latest generation of 14.4-volt drills. Many of these tools weigh about the same as 12-volt models did only five years ago, yet deliver more twisting force and drive more screws before they need recharging.

There's another reason to consider stepping up in voltage: Many 14.4-volt drills sell in combo kits with other handy cordless tools, such as power planers, jigsaws, and circular saws. High-voltage batteries (18 and 24 volts) will power even more demanding tools, but the added weight (and cost) makes them less attractive to woodworkers.

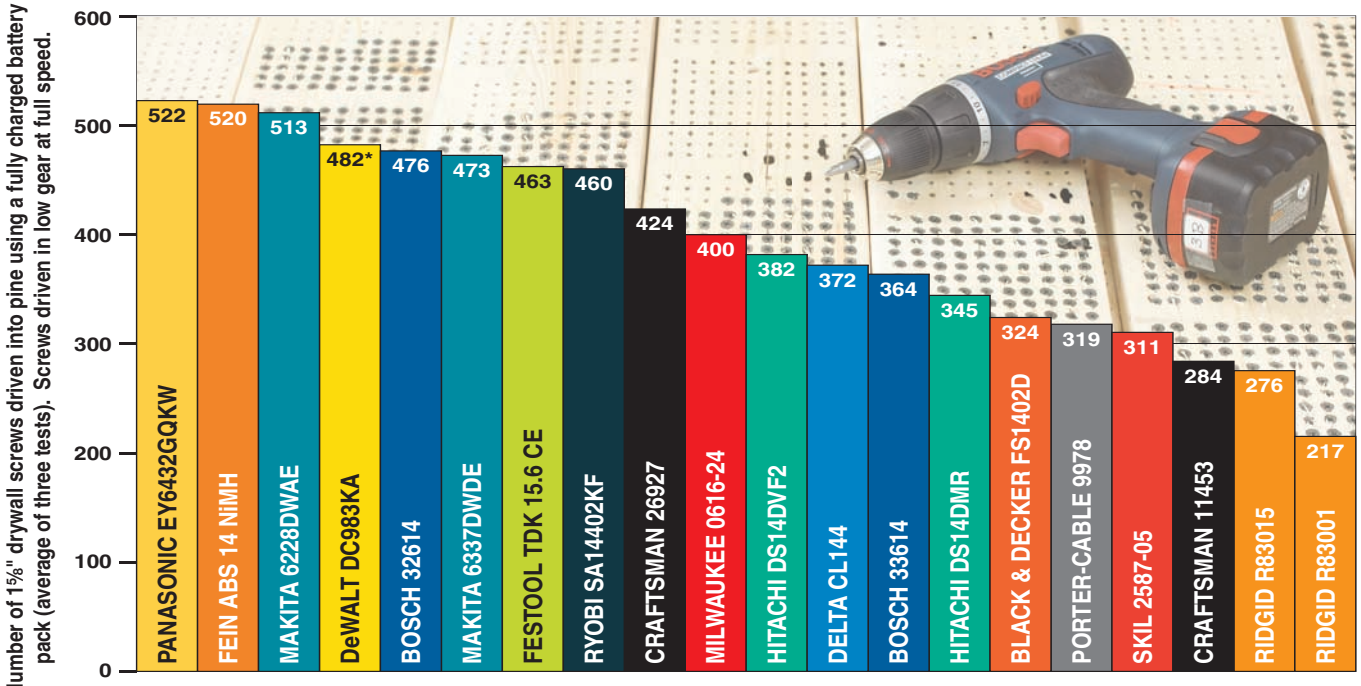
So which mid-voltage cordless drill is right for you? To find out, we gathered 20 models—mostly 14.4-volt drills, but also a couple of 15.6-volt tools from manufacturers that don't sell 14.4-volt models—and put them through a raft of tests. Before we began any performance testing, we charged and discharged all of the batteries four times to bring them up to peak capacity.

Five key measures of a quality cordless drill/driver

• ***Torque.*** When most of us talk about a drill's power, we're really talking about how much rotational force, or *torque*, it can produce. Manufacturers rate their maximum torque in inch-pounds, and we found those ratings a pretty good indication of the drill's true ability. For this article, we assessed torque in a practical way: by driving progressively larger diameters of 2" lag screws. As you can see from the "Trustworthy Torque Specs" chart, at *far right*, all of the drills drove 5⁄16" lags into pine without difficulty, some strained while driving 3⁄8" and 1⁄2" lags, and a few couldn't fully seat 1⁄2" lags.

• ***Run time.*** If torque is like the horsepower of your car's engine, run time is like mileage—how far it will go on a tank of fuel. The "tank size" of a battery pack is measured in *amp hours*. (See the chart at the *end of the article* for amp-hour ratings.) However, efficiency comes into play too. So just as a Honda will go farther than a Hummer even though it has a smaller tank, a high amp-hour rating doesn't guarantee long run time.

DRIVING SCREWS: A MEASURE OF HOW LONG A BATTERY WILL LAST BETWEEN CHARGINGS



*Middle gear setting used for this test. In low gear this model averaged 283 screws per charge.

To get a handle on these drills' run times, we drove screws (*lots and lots* of them) into pine with each tool until the battery pack ran out of juice, and then counted the number of screws driven per charge. The "Driving Screws" chart, *above*, shows the result of that testing.

The top-performing drills in this test drove between 460 and 522 screws on a single charge—more than twice the number of the Ridgid R83001 (217 screws). Ridgid's Bryan Whiffen told us, "With all cordless tools, there are trade-offs between run time and maximum torque. Paired with the Rapid Max charger [that] charges two batteries in 30 minutes or less, [you have] the power to tackle any task and the ability to work continuously."

For consistency, we tested all the drills in low gear at full speed, but you may be able to extend run times by using high gear and a slower trigger speed. For example, the DeWalt drill has a unique middle gear setting, (shown on the *next page*) designed specifically for driving screws. When we tested that drill in low gear, we averaged only 283 screws per charge; switching to middle gear netted nearly 200 more screws per charge.

TRUSTWORTHY TORQUE SPECS

In our tests, a drill's "maximum torque" specification proved to be a reliable indicator of its power. We drove 2"-long lag screws of three diameters into construction-grade pine using the drill's lowest gear (highest torque setting). This chart shows how the drills performed for each screw size. All tests were conducted with a fully charged room-temperature battery pack.

Brand and model	Diameter of lag screw driven (1) 5/16"	3/8"	1/2"	Max. torque rating (2)
MILWAUKEE 0616-24	●	●	●	460
HITACHI DS14DMR	●	●	●	450
DeWALT DC983KA	●	●	●	450
BOSCH 33614	●	●	●	450
PORTER-CABLE 9978	●	●	●	420
FESTOOL TDK 15.6 CE	●	●	●	320
RIDGID R83015	●	●	◢	415
CRAFTSMAN 11453	●	●	◢	410
RIDGID R83001	●	●	◢	400
PANASONIC EY6432GQKW	●	●	◢	390
MAKITA 6337DWDE	●	●	◢	350
FEIN ABS 14 NiMH	●	●	◢	327
BOSCH 32614	●	●	◢	300
CRAFTSMAN 26927	●	◢	◢	275
RYOBI SA14402KF	●	◢	◢	270
DELTA CL144	●	◢	◢	250
BLACK & DECKER FS1402D	●	◢	○	235
SKIL 2587-05	●	◢	○	250
HITACHI DS14DVF2	●	◢	○	213
MAKITA 6228DWAE	●	◢	○	200

Notes:
1. ● Drove 2" lag screw easily. ◢ Drove 2" lag screw with a little difficulty. ◢ Drove 2" lag screw with great difficulty. ○ Could not completely drive 2" lag screw.
2. Rating provided by manufacturer.

THREE SPEEDS ARE BETTER

Between the typical high and low gears, DeWalt added a middle gear with enough torque to drive screws, yet at a faster rate, drastically increasing run time.

WHAT TO LOOK FOR IN A CORDLESS-DRILL CHUCK

A single-sleeve chuck tightens with only one hand. A double-sleeve chuck requires two hands in close proximity, resulting in a chuck that's "finger tight" rather than "hand tight."

Serrated jaws sport a ridge or ridges along the length of each jaw to apply a more secure grip on round-shank bits. In our tests, smooth jaws tended to slip easier.

• ***Chuck grip.*** With ¼" hex-shank drill and driver bits available practically everywhere, a drill chuck's ability to hold fast on a round-shank bit means somewhat less than it used to. (In fact, two drills in our test—Black & Decker FS1402D and Festool TDK 15.6 CE—both come equipped with chucks designed specifically for quick-release hex-shank bits as well as a traditional three-jaw chuck.) Still, drills with this much power should be able to grip a round-shank drill bit well enough to keep it from slipping.

To test for chuck slippage, we cut off the threaded portion of ⅜×4" hexhead bolts, leaving each with a smooth 2" shank topped by a hex head. After chucking one bolt into each of the drills, tightening as much as we could by hand, we used a dial-type torque wrench with a needle that "remembers" the maximum torque when the bolt slipped within the jaws of the chuck. The chart *at right* shows the results.

As you can see, five chucks maxed out our torque wrench at 600 inch-pounds. So how much grip is necessary? For comparison purposes, we bored holes into white oak with a 2" Forstner bit in each drill. That round shank slipped in all of the drills that slipped at 120 inch-pounds or less on our test shanks.

The top-performing chucks are a ratcheting style that actually increases its grip on the bit as torque increases. Most also use a big single-sleeve chuck for one-handed tightening. (See photo *above*.) And many good-gripping chucks employ serrated jaws that bite into the bit better to prevent slippage (see photo *above right*). Most of the chucks that easily slipped lack two, or even all three, of these qualities. Hitachi's Kevin Fairchild says they'll probably upgrade the chuck on the DS14DVF2 when they revamp the tool in 2005.

• ***Clutch consistency.*** All of the tested drills have an adjustable clutch between the chuck and the nose of the drill. A clutch stops the chuck from turning when it encounters a set amount of resistance, preventing the drill from shredding the screw head, breaking the screw, or driving it too deep into the wood.

Although manufacturers like to boast of how many clutch settings their drills have, we found little difference in drive depth between the top, middle, and bottom of the clutch range from drill to drill, regardless of the actual number of settings.

• ***Batteries and chargers.*** The two drills that topped our run-time tests both use nickel-metal hydride (NiMH) batteries, which are

Model vs. model: a no-spin review of the

Black & Decker FS1402D, $90
800/544-6986, blackanddecker.com

Pop off the three-jaw chuck and underneath you'll find a driveshaft that accepts ¼" hex-shank quick-connect bits (similar to the Festool chuck shown in the photo at *far right*). Remount the three-jaw chuck and it's the longest drill in the test, and a bit front-heavy. The FS1402D has pretty good power for a $90 drill, but the short run time and 2-hour charger kept us waiting.

Bosch 33614, $190
877/267-2499, boschtools.com

Bosch calls this drill "brute tough," and it lives up to that name. It drove ½" lag screws easily in our tests, and still felt comfortable and well-balanced in hand. The middle-of-the-pack run time is offset by a fast charger that tops off batteries in about half an hour. The chuck lost its grip at only 172 inch-pounds in our test, but didn't slip when boring with a 2" Forstner bit into white oak.

Craftsman 26927, $170
Visit Sears or craftsman.com

This drill feels well-balanced in the hand and drives ½" lag screws with little effort. The trade-off for that power, though, is below-average run time. The 26927's large diameter single-sleeve chuck tightens easily and didn't allow the Forstner bit to slip in our tests. As with the Craftsman 11453, we felt that the forward/reverse switch could have been placed within easier reach.

Bosch 32614, $150
877/267-2499, boschtools.com

We like the maneuverability of this drill: Its compact size and light weight means you can use it all day without fatigue. And, with a near-the-top run time (476 screws per charge), you probably could use it all day without recharging. The only thing limiting this drill is its ⅜" chuck, which prevents running ½"-shank bits.

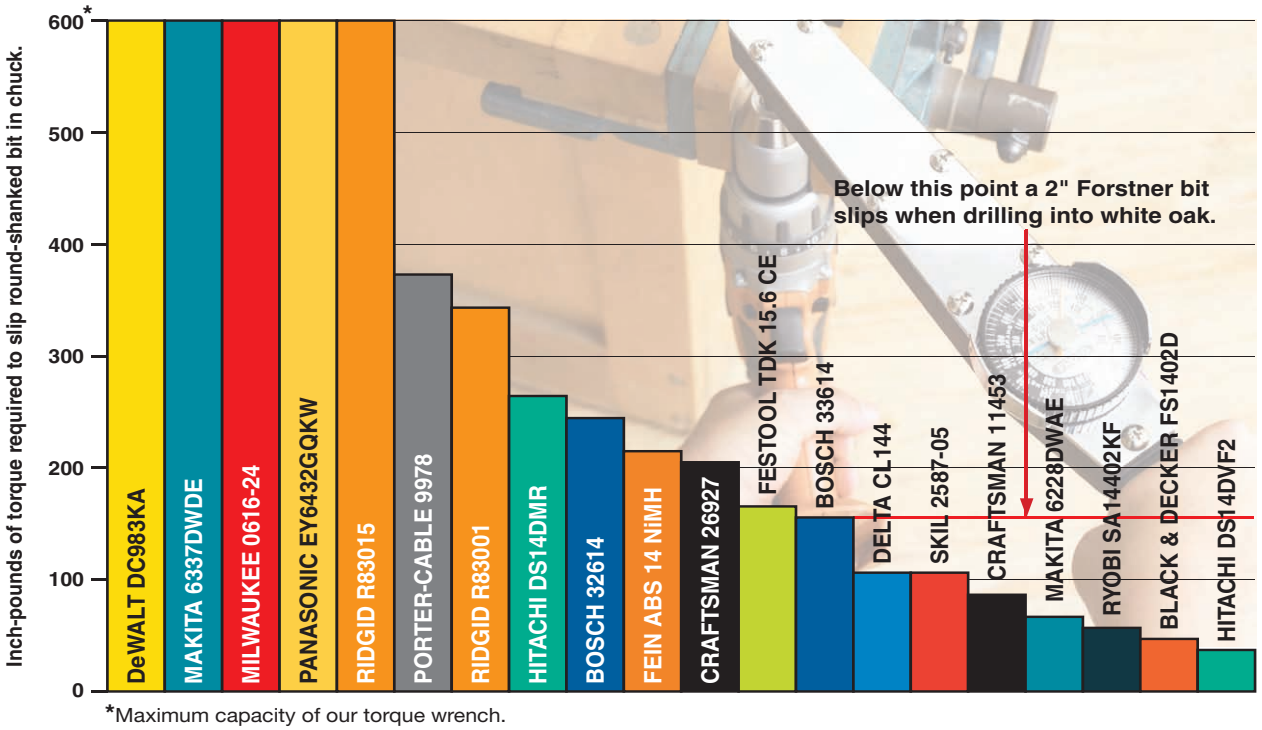
Craftsman 11453, $90
Visit Sears or craftsman.com

On the plus side, the 11453 achieved mid-range run time, and proved capable of driving ½" lags, though with some difficulty. However, the ⅜" dual-sleeve chuck slipped on our 2" Forstner bit, and we found the forward/reverse switch difficult to reach. A bubble level on the back of the tool helps when drilling plumb holes.

Delta CL144, $70
800/793-9169, deltamachinery.com

This drill turned in a decent performance—mid-range run time and the ability to sink ½" lag screws (albeit with a lot of strain). But the small dual-sleeve chuck is hard to tighten, which may have contributed to it slipping under 120 inch-pounds of torque. Also, the 330-rpm top speed in low gear is noticeably slower than most other drills in the test.

SOME CHUCKS HOLD BITS BETTER THAN OTHERS



*Maximum capacity of our torque wrench.

purported to offer long run times. However, nickel-cadmium (NiCd) batteries were close behind, so don't make battery chemistry an issue unless cost or extreme temperatures are major concerns to you. (Learn more about cordless tool batteries on *page 82*.)

Also consider how the battery pack attaches to the drill. We prefer packs that slide onto the bottom of the drill to those with a post that inserts into the drill handle because the release buttons for slide-mount packs are typically easier to reach, even for small hands. We significantly downgraded only two battery packs: The single release button on the Porter-Cable 9978 is clumsy, especially for left-handed users; and Ryobi's battery pack sometimes locked in cockeyed.

Most of the battery chargers we tested fully charge a drained pack in about one hour, give or take. (Faster chargers are available for some drills as an accessory.) However, the Bosch 33614 and Ridgid chargers filled 'em up in about 30 minutes, getting us back to work quicker. (In fact, the Ridgid R83015's dual "Rapid Max" charger can charge *both* of its batteries simultaneously in that same 30 minutes.) Black & Decker's batteries charged slowest, at two hours, with Ryobi and Skil taking about 90 minutes each.

20 drills in our test

DeWalt DC983KA, $200
800/433-9258, dewalt.com

Finishing at or near the top in every performance area, we can't say enough good things about this tool. Although the DC983KA is one of the heavier drills in the test, it's well balanced and it feels good in the hand. The three-speed gear box lets you choose between high torque for demanding tasks, middle speed/middle torque, and a test-high 1,800 rpm for cleaner drilling.

Fein ABS 14 NiMH, $240
800/441-9878, feinus.com

Good torque, excellent run time, and great ergonomics put this drill well into the top half of our test group. We were surprised, though, that it lacks externally replaceable motor brushes. You can get a NiCd-battery operated version of this tool (ABS 14 NiCad) for $30 less—however, the drill's run times may be affected.

Festool TDK 15.6 CE, $375
888/337-8600, festool-usa.com

One of only two 15.6-volt drills in our test—and the most expensive—the TDK 15.6 CE earned high marks in most key performance areas. This tool's unique interchangeable chuck system expands its versatility: The three-jaw chuck pops off to reveal a ¼" hex drive (shown at *right*), and the included Centrotec chuck accepts Festool's own specially designed quick-release bits.

Hitachi DS14DVF2, $95
800/829-4752, hitachipowertools.com

This drill is the lightest in the test and one of the smallest, making it a good candidate for work in tight spots. But the DS14DVF is strictly a light-duty tool—it doesn't have the horses to fully seat a ½×2" lag screw in pine, and the chuck slipped easily on our 2" Forstner bit. (Hex-shank bits would be fine, though.) This kit includes a flashlight.

CHUCK OPTIONS GALORE

Four different add-on chucks—two standard equipment, and two optional—make the Festool TDK 15.6 CE a versatile switch-hitter in your shop. With none of the chucks mounted, the ¼" hex drive accepts standard quick-release bits and makes the drill barely longer than its battery pack.

HANGING OUT IN THE DARK

The integrated LED work light on the Hitachi DS14DMR's belt hook helps you work in low-light situations. The hook rotates to five different positions to direct the light.

Hitachi DS14DMR, $190
800/829-4752, hitachipowertools.com

With lots of torque and above-average run time, the DS14DMR features a built-in belt hook/work light (shown *above*), so it's always hanging around, ready to work. Depending on its position, however, the hook sometimes interfered with battery changes and when drilling left-handed.

Makita 6228DWAE, $140
800/462-5482, makitatools.com

With one of the longest run times in the test, this compact drill will drive a lot of screws (we averaged 513) on a fully charged battery. Like the Hitachi DS14DVF2, though, it couldn't fully seat a ½" lag and the small double-sleeve chuck slipped on round-shank bits under relatively low torque.

FROM DRILL TO DRIVE IN AN INSTANT

Makita's 6337DWDE features a switch that disables the clutch in "drill" mode (above) for full-on power. Flipping back to "drive" mode (inset), re-engages the clutch at its most recent setting.

Makita 6337DWDE, $180
800/462-5482, makitatools.com

Good power and run time characterize this tool, along with a great-gripping chuck that maxed out our torque wrench at 600 inch-pounds. Unique to this drill is its "shift lock" (shown *below left*) that allows you to switch from drilling to driving without changing the clutch setting. We sometimes found the lock difficult to engage and release.

Milwaukee 0616-24, $200
800/729-3878, milwaukeetoolcom

Milwaukee's maximum-torque spec of 460 inch-pounds is the highest of the tested tools, and this drill drove ½" lags effortlessly. Its ratcheting single-sleeve chuck is one of six that didn't slip when subjected to 600 inch-pounds of torque. We also like its one-of-a-kind reversible battery pack, shown *below right*. On the downside, the 0616-24 weighs nearly 6 lbs and run time was about in the middle of the pack.

Panasonic EY6432GQKW, $200
800/338-0552, panasonic.com

A 15.6-volt NiMH battery pack drives this drill to the top of the run-time test, sinking 522 screws on a single charge. It was also one of the six tested tools whose chuck grip exceeded 600 inch-pounds, and it strained little while driving ½" lags into pine. Wrap it all up in a well-balanced compact body that's maneuverable in tight spaces, and you'll understand why we like this tool.

Porter-Cable 9978, $190
800/793-9169, porter-cable.com

One of the top torquers in the test, the 9978 easily sank ½" lag screws, and its single-sleeve ratcheting chuck kept a tenacious grip on bits. We like the "grip-to-fit" feature on this tool, where you can install inserts to customize the handle size to fit your hand, but were less thrilled with changing battery packs because of the way the slide catch releases from only one side of the pack.

Ridgid R83001, $170
866/539-1710, ridgid.com

The R83001 has plenty of power, but we were disappointed in its run time, averaging fewer than 220 screws per charge. The fastest charger in the test (23 minutes to top off a fully drained battery pack) helps offset that shortcoming, though. You'll have to work to make a bit slip in this chuck.

Ridgid R83015, $220
866/539-1710, ridgid.com

With power about equal to the Ridgid R83001 and a little better run time, what do you get for stepping up $50 from that model? A dual battery charger, one of the best-gripping chucks in the test, and about 1½ lbs of extra weight. The R83015 is the heaviest tool we tested, and one of the largest, at 10½" long and 10⅜" tall.

Ryobi SA14402KF, $80
800/525-2579, ryobitools.com

One of the big surprises of the test is that this $80 drill averaged 460 screws per charge, putting it in the run-time company of other drills that cost two to three times as much. The SA14402KF was able to fully seat a ½" lag, but with a lot of strain. We were disappointed in its chuck, which slipped on our 2" Forstner bit, and in battery pack insertion, where the pack often locked into the drill slightly askew. A flashlight comes with this kit, boosting its value.

Skil 2587-05, $80
877/754-5999, skil.com

What the 2587-05 lacks in power, run time, and chuck grip, it makes up for in features. We like the large two-finger trigger and charge indicator on the battery (like a fuel gauge, it shows the level of charge in the battery with a series of LEDs). It also sports an onboard bit storage case and forward/reverse indicator lights. Although the 2587-05 isn't a tool for serious woodworking, it's a good drill to keep on hand in the house for the occasional drilling or driving job.

MOVE THE PACK FROM THE FRONT TO THE BACK

Milwaukee's battery pack slides in from the front of the tool for optimum balance, or from the back, as shown here, to provide extra clearance in tight quarters.

GETTING A GRIP ON 20 CORDLESS DRILLS

			BATTERY PACK						CHUCK										SIZE (7)		PERFORMANCE GRADES (8)									
BRAND	MODEL	VOLTS	TYPE (1)	AMP-HOUR RATING (2)	BATTERY MOUNTING STYLE (3)	CHARGE TIME (4)	REPLACEMENT BATTERY COST (5)	CAPACITY (INCHES)	RATCHETING? (YES/NO)	SINGLE OR DOUBLE SLEEVE	SERRATED JAWS? (YES/NO)	NUMBER OF REVOLUTIONS FROM OPEN TO CLOSE	MAX SPEED, HIGH GEAR (RPM) (6)	MAX SPEED, LOW GEAR (RPM)	REPLACEABLE BRUSHES? (YES/NO)	DRIVER-BIT STORAGE? (YES/NO)	LENGTH x HEIGHT (INCHES)	WEIGHT (POUNDS)	POWER (TORQUE)	RUN TIME	CHUCK GRIP	DROP TEST DURABILITY	EASE OF CHANGING BATTERY PACK	BALANCE OF TOOL	WARRANTY (YEARS) (9)	COUNTRY OF ASSEMBLY (10)	SELLING PRICE (11)
BLACK & DECKER	FS1402D	14.4	NiCd	1.5	S	120	43	3/8	N	D	N	16	1,200	400	N	Y	11 7/8 x 10 1/4	4.7	B	C	C-	B	A	B	2	CH	$90
BOSCH	32614	14.4	NiCd	2.0	P	65	51	3/8	Y	S	Y	16.5	1,200	400	N	Y	8 5/8 x 10	4.3	B	A-	B	A	B	A	1	S	150
	33614	14.4	NiCd	2.0	P	28	51	1/2	Y	S	Y	13	1,400	450	Y	Y	9 5/8 x 10 3/8	5.4	A	B	B-	A	B	A	1	S	190
CRAFTSMAN	11453	14.4	NiCd	1.4	P	59	45	3/8	N	D	N	20	1,400	400	N	Y	8 5/8 x 9 3/4	4.2	B	B	C-	A	B	A	1	CH	90
	26927	14.4	NiCd	1.7	S	57	55	1/2	N	S	N	23	1,400	350	N	N	9 x 9 5/8	4.8	A-	C-	C	A	B-	A	1	CH	170
DELTA	CL144	14.4	NiCd	1.5	S	51	45	3/8	N	D	N	14	1,100	330	N	Y	9 3/8 x 9 3/4	4.5	B	B	C	A	B	B	2	CH	70
DeWALT	DC983KA	14.4	NiCd	2.4	P	63	48	1/2	Y	S	N	15	1,800*	450	Y	Y	9 7/8 x 9 3/8	5.5	A	A	A	A	A	A	3	MX	200
FEIN	ABS 14 NiMH	14.4	NiMH	3.0	S	52	110	1/2	Y	S	Y	20	1,400	400	N	N	9 1/4 x 9 1/2	4.8	B	A	B-	A	A	A	1	CH	240
FESTOOL	TDK 15.6 CE	15.6	NiCd	2.4	S	48	96	1/2	Y	S	Y	20	1,500	450	Y	Y	9 1/16 x 9 1/16	5.2	A	A-	B-	A	A	A	3	G	375
HITACHI	DS14DMR	14.4	NiCd	2.0	P	45	70	1/2	Y	S	Y	20	1,500	400	Y	Y	9 3/8 x 9 1/2	5.4	A	B-	B	A	B	A	5	CH	190
	DS14DVF2	14.4	NiCd	1.2	P	58	50	3/8	N	D	N	19	1,200	400	N	Y	8 1/4 x 9	3.7	C	B	C-	A	A	A	5	CH	95
MAKITA	6228DWAE	14.4	NiCd	2.2	P	55	69	3/8	N	D	N	25.5	1,100	350	N	N	8 1/4 x 9 5/8	3.8	C	A	C-	A	A	A	1	CH	140
	6337DWDE	14.4	NiMH	2.6	P	54	77	1/2	Y	D	Y	20.5	1,300	400	Y	Y	9 1/2 x 10	4.9	B	A-	A	A	A	B	1	MX	180
MILWAUKEE	0616-24	14.4	NiCd	2.4	S	65	71	1/2	Y	S	Y	24	1,700	500	Y	N	10 1/4 x 9 3/4	5.8	A	B	A	A-	B	A	5	CZ	200
PANASONIC	EY6432GQKW	15.6	NiMH	3.5	P	56	95	1/2	Y	S	N	22	1,450	450	N	N	8 1/4 x 9	4.8	A-	A	A	A	B	A	1	MX	200
PORTER-CABLE	9978	14.4	NiCd	2.0	S	60	62	1/2	Y	S	Y	22	1,400	450	N	Y	10 1/8 x 9 5/8	5.6	A	C	B	A	C	B	1	T	190
RIDGID	R83001	14.4	NiCd	1.3	S	23	60	3/8	Y	S	N	12.5	1,400	400	N	Y	9 3/4 x 9 1/2	4.8	A-	D	B	A	A	A	3	CH	170
	R83015	14.4	NiCd	1.9	S	32	60	1/2	Y	S	N	15	1,600	400	N	Y	10 1/2 x 10 3/8	6.4	A-	C-	A	A	A	A	3	CH	220
RYOBI	SA14402KF	14.4	NiCd	1.7	P	95	24	3/8	N	D	N	19.5	1,400	400	N	Y	9 3/4 x 9 3/4	4.4	B	A-	C-	A	C	A	1	CH	80
SKIL	2587-05	14.4	NiCd	1.2	S	93	49	3/8	N	S	N	14.5	1,250	400	N	Y	9 3/4 x 9 5/8	3.9	C	C	C	A	A	A	2	MA	80

NOTES:

1. (NiCd) Nickel-Cadmium
   (NiMH) Nickel-metal Hydride
2. Rating provided by manufacturer
3. (P) Post mount
   (S) Slide mount
4. Number of minutes to charge fully discharged, room-temperature battery. Average of three tests.
5. At time of article production.
6. *This drill also has a middle gear its maximum speed is 1,400 rpm.
7. Including battery pack
8. A Excellent
   B Good
   C Fair
   D Poor
9. Warranty on tool only. Battery warranty may or may not be shorter.
10. (CH) China
    (CZ) Czechoslovakia
    (G) Germany
    (MA) Malaysia
    (MX) Mexico
    (S) Switzerland
    (T) Taiwan
11. Prices current at time of article production and do not include shipping, where applicable.

These are the drills we'd want in our shop

After months of testing, we picked three drill/drivers for Top Tool accolades. The DeWalt DC983KA is our first choice: It earned high marks in every performance area, comes with a 3-year warranty, and it would be equally at home in a woodworking shop or on the job site.

We also awarded Top Tool seals to the Festool TDK 15.6 CE and the Panasonic EY6432GQKW, for different reasons. The compact Panasonic had the best run time in the test and almost as much power as the DeWalt, but in a more compact, less weighty tool. The Festool, with its included and optional accessory chucks, will get you out of—or should we say "into"—some tight spots that only woodworkers can appreciate. That versatility comes with a price, however.

Don't have $200 or more to burn on a cordless drill? None of the lower-priced drills demonstrated the high torque of the big boys, but the Ryobi SA14402KF had run time about equal to the more-expensive tools—and you get a handy flashlight to boot—all for only $80. So we named it our Top Value.

Written by **Dave Campbell** with **Pat Lowry**

SHOP-TESTED TECHNIQUES

low-fuss, less-dust sanding

Though necessary, sanding is tedious and boring. Cut to the quick with these time-savers and you'll achieve smooth results in a hurry.

Sanding is like doing taxes. The payoff doesn't make the paperwork more pleasant. In both cases, you face big penalties for hasty mistakes or cutting corners. Unfortunately for woodworkers, you sand more than once a year and you can't hire someone to do it for you.

So, what's to like about sanding? The repetitive movements? The dust? The suspicion that your first coat of stain will betray every little mistake? We can't make sanding fun, but we can offer you ways to get top-notch results with no wasted effort.

For starters, picture what happens when sanding grit touches grain. Sandpaper abrasives work like a series of tiny plane blades, scraping off fine particles of wood with each pass. Coarse grits remove machining marks, medium grits obliterate the coarse scratches, and increasingly finer grits erase scratches made by the previous grit, ending with scratches too fine to detect.

Give yourself less to sand

Maintaining or adjusting your tools takes time, but not as much time as sanding off deep scratches, ridges, or burn marks left by dull or nicked cutting tools. Replace worn or low-cost saw blades with long-wearing carbide ones. Sharpen or replace dull or nicked jointer knives, and upgrade your most frequently used router bits. Each of these precautions brings you closer to starting with a smoother surface.

Glue globs can scratch the surface of your work either when they break loose or become trapped on your sanding pad.

Time-saving tips: As you machine workpieces, cut any curves as precisely as possible. If you bandsaw a curve to within 1/32" of your pattern line, you'll waste less time using your sander as a shaping tool.

On glue-ups, scrape away globs of squeeze-out while they're still pliable instead of sanding off dried chunks. Bits of dried glue can attach themselves to your sandpaper or break loose from the joint, as shown *above*, turning into giant abrasive grits that will mar the surface of your work.

Stock up on sandpaper

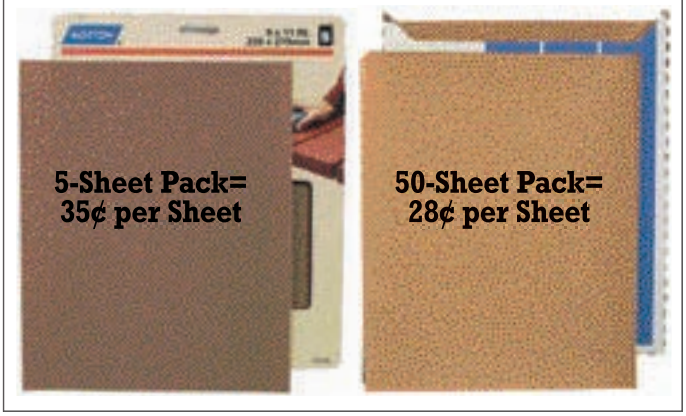
Now gather your sanding tools. For sanding flat surfaces, a random-orbit sander works best because its pad leaves behind small irregularly spaced swirls. Other types of sanders work better for curves or help preserve square edges. To help you sort out the best tools for your sanding needs, consult "Sander Types and Their Uses," *below*.

With your sanding tools at hand, it's time to stock up on a broad assortment of coated abrasive papers, from 80 grit on the coarse side all the way through 320 grit for fine dry sanding and scuff sanding between coats of finish. If you'll eventually rub out your finish topcoats, add some 600-grit wet/dry paper to your shopping list. Use the sanding grit chart on *page 79* as a reference. It shows the different grits in both major measuring systems and how abrasive grain sizes shrink as the grit number increases.

Time-saving tip: Depending on the type and amount of work you'll be doing, save time and money by buying sandpaper in bulk packs or rolls instead of the 5-packs on many store shelves. That way, you'll be more likely to have the abrasive you need when you need it, giving you fewer excuses for wearing down paper to the backing for want of a replacement. Change sandpaper as soon as it ceases to remove stock efficiently.

In addition, bulk sandpaper packs save money two ways. For example, we bought a 5-pack of 9×11" aluminum oxide paper for what came to 35 cents a sheet at a local store, compared to 28 cents per sheet for a 50-pack purchased by mail. The $3.50 you save for 50 sheets isn't a fortune, but you've also avoided as many as 10 trips to the store. Don't need that much sandpaper? Buy in bulk and split the cost and sandpaper with your woodworking buddies.

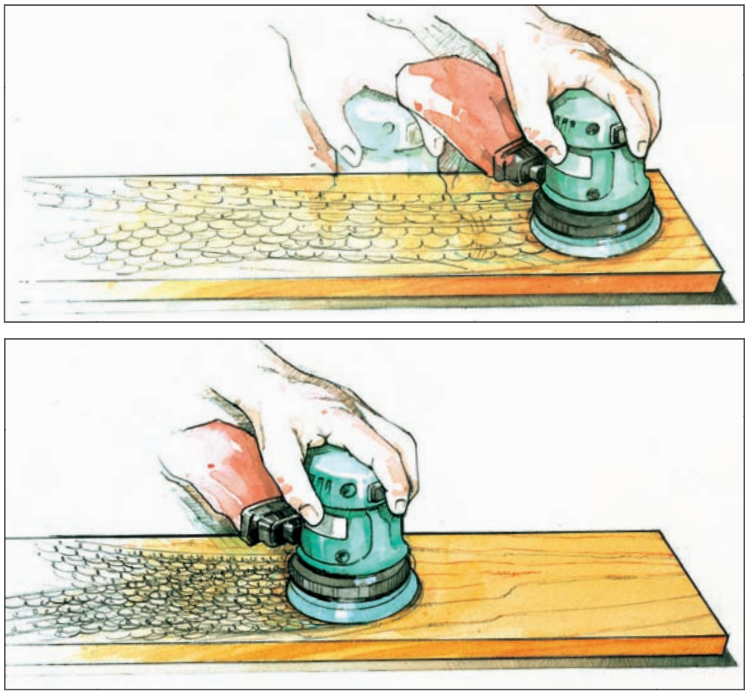
BULK SANDPAPER SAVES MONEY AND TIME



Sander types and their uses

type	belt	detail	finish		rotary tool	disc	drum	oscillating spindle
uses	Rapid stock removal; shaping wood	Reaches into corners and tight spots; some models have attachments for sanding contours	Fine sanding; reaches into corners of flat surfaces	Flat surfaces and large panels; random action helps lessen swirl marks on stained surfaces	Tight curves and hard-to-reach areas; valuable where light weight and portability are important	Flat surfaces and outside curves; preserves 90° angles or miters; fast and precise stock removal; can be used to bevel	Fine-tunes stock thickness; produces uniform scratch marks; excellent for thicknessing figured stock prone to tearout	Sands edges at 90° angle; handles inside curves; less prone to burning hardwoods; multiple spindle diameters
limitations	Hard to control for precise sanding; gouging is a risk if not carefully controlled	Not suited for large areas	Less aggressive than random-orbit sanders; more apparent swirl marks than with a random-orbit sander	Doesn't sand curved surfaces, inside corners, and profiled or narrow edges	Few grit options; loads with debris quickly; can gouge wood; less precise than a spindle sander; not for flat surfaces	Can't reach inside curves; burns hardwoods easily; limited to workpieces half the diameter of the sanding disc	Limited to flat surfaces up to twice the width of the drum (on open-ended models); high prices	Only suitable for sanding edges, not flat surfaces

SLOW DOWN FOR EVEN FINISHES



Moving a random orbit sander too quickly across the face of your work, as shown at *top*, prevents individual swirl marks from overlapping and concealing each other, as they do in the lower example.

Set a pace, not a race

Repetitive sanding movements can quickly reinforce careless techniques, turning them into habits. Develop the right sanding routines, though, and you'll train yourself how to create the right surface for a flawless finish.

For instance, hand-sanding conditions you to rapidly move the sanding pad back and forth across the surface, so you repeat those motions using your power sander and end up with strings of swirl marks. Random-orbit sanders make hundreds of tiny swirls per minute, but even those speeds aren't fast enough to leave a smooth surface if the swirls aren't connected. Move the sander slowly enough that the swirls overlap and partially erase each other, as illustrated *above*.

To create interlocking swirls, develop a consistent sanding pace suited to your sander's operating speed. For example, a random-orbit sander that makes 3/32" orbits leaves roughly 11 swirls per inch. For those swirls to interconnect at all, you need at least 22 swirls per inch or 264 per foot. On a random-orbit sander producing 200 orbits per second, that means moving the sander slower than one foot per second just for the bare minimum of interconnected swirls. The slower you move, the more interconnected your swirls become and the more they cancel out each other. Practice with your sander until you discover the quickest pace that's swirl-free.

A uniform sanding pace also produces more consistent finishing results on each workpiece and among pieces in a project, so practice pacing how rapidly you move your sander until that pace becomes a habit.

The edges of a flat surface present special sanding problems that show up after your stain soaks in. In the usual back-and-forth sanding motion, the far edges get one pass for every two trips the sander makes across the center. If the wood is going to receive a natural finish, that's not a problem. But if the wood is going to be stained, more pigment will lodge in the less sanded ends and edges than the smoother middle, throwing off the color of the finished piece.

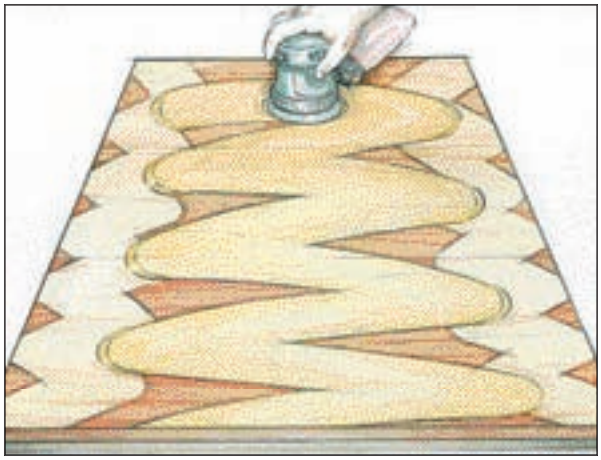
For a solution, divide the surface into three parts—two ends and the middle, as illustrated *above right*. Sand the ends thoroughly before doing the middle, which will connect all three areas.

End-grain presents another set of problems when you're preparing wood to be

(Continued on page 80)

HOW TO AVOID GOOFS

Uneven sanding—especially around the edges of flat surfaces—will lead to blotchiness on stained areas.



For consistent smoothness, sand the edges of a flat panel separately from the center portion. Make an equal number of passes on all three sections.

Random-orbit sanders work with or across the grain. Make a habit of sanding with the grain to lessen the impact of mistakes. On a door such as this, sand the rails first. Any cross-grain oversanding disappears as you sand the stiles.

Sanding facts at a glance

Time-saving tips

Don't oversand. For most woods with typical machining marks, start at 120 or 150 grit and work your way up to 220 grit.

Sand less when not staining. Stain pigments emphasize swirl marks and unevenness, but clear finishes do not accentuate sanding scratches.

Forgiving finishes. Satin finishes are more forgiving of a less-than-perfect sanding job than gloss finishes.

Fine-sand turnings. Take your turnings up to 600 grit to conceal cross-grain scratches.

Sand, then assemble. Some parts can be hard to sand on a completed project. Identify them from the start, and sand them prior to assembly.

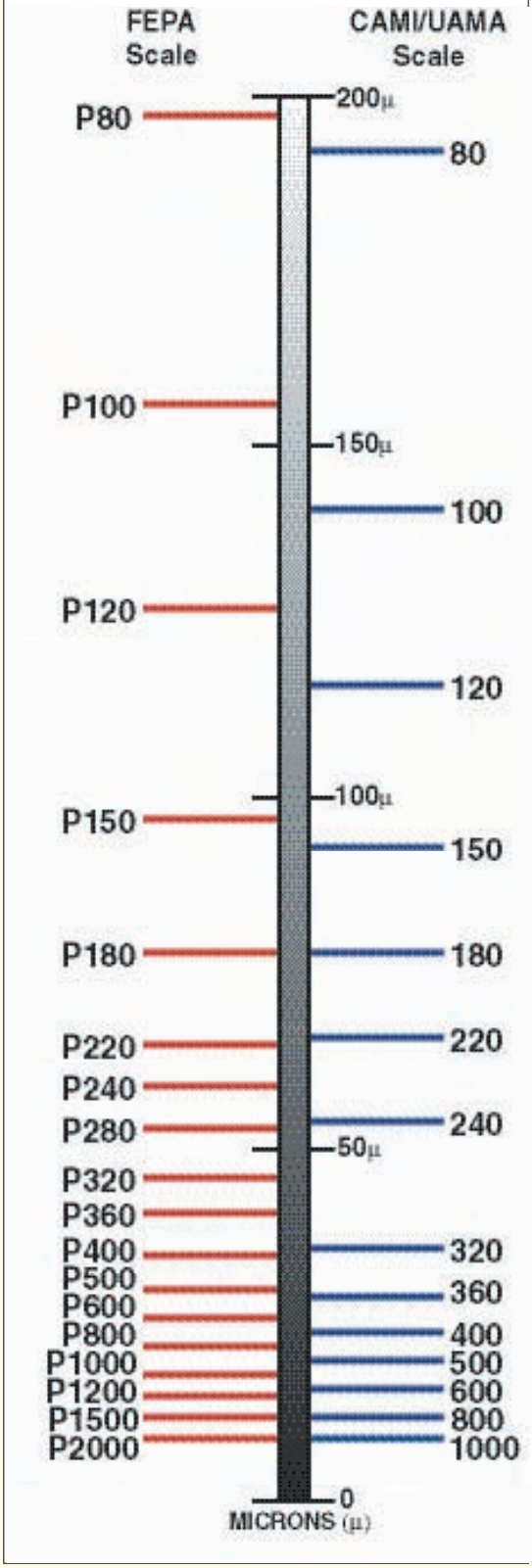
Breathe easy. It's hard to focus on your work while choking on clouds of sawdust. Invest in a respirator, dust collection system, and air filtration.

Pad your work. Why mar one face of your work while you sand the other? A router pad both cushions and holds your workpiece as you sand.

Going in circles. For curved or round surfaces, such as spindles, use a sanding sponge that molds itself to the workpiece.

Common Sanding Grits

Abrasives graded on the Federation of European Producers of Abrasives (FEPA) system have a "P" before the number. CAMI/UAMA refers to the Coated Abrasives Manufacturers' Institute/Unified Abrasives Manufacturers' Association.



Sandpaper Terms

Backing. Usually paper or cloth to which abrasive grains are bonded. Paper is used mostly for sheets and discs that can take advantage of its low cost. Cloth is used for belts, rolls, some discs, and wet-dry sheets where durability is essential. Both come in various thicknesses.

Bond. Coats of adhesive that hold grit onto a backing. This can be in the form of a glue or, for greater durability, a resin.

Closed coat. Backing completely covered with abrasive grains. This helps increase the abrasive's power on bare wood but also increases the likelihood of clogging, or loading, in such applications as removing paint. For comparison, see "open coat" below.

Coated abrasive. Technical term for sandpaper. It refers to an abrasive product combining a backing, bond, and abrasive material.

Cut rate. The speed with which an abrasive removes material.

Friable. The ability of abrasive grains to fracture into smaller but resharpened particles with use.

Grain. Material crushed to form abrasive granules. This can be natural material, such as garnet, or synthetics, such as aluminum oxide.

Grit. This number indicates abrasive grain size, as measured in the quantity of openings per linear inch in a screen through which the grain will pass. The two main grading systems are explained and compared at *left*.

Loading. Sawdust and grit buildup between or covering the abrasive grains, making the sandpaper less effective. Buildup can be removed with a rubber cleaning stick or reduced with the use of open coat or stearated sandpaper.

Open coat. Backing that's 40–70 percent covered with abrasive grains. Reducing the coverage helps lessen clogging from pitch or paint.

Scuffing. Mildly abrading a surface to remove raised fibers or help a finish bond to itself between coats.

Stearate. A dry lubricant, often zinc, that prevents coated abrasives from clogging during use.

Wearing down a sanding disc to the cloth or paper backing costs you hours to save pennies. If you can't see or feel the grit working, change discs and toss out the old one.

stained. Sand end-grain two grits above what you sand the face. If you stop at 180 grit on the face, for example, sand the ends to at least 320 grit to keep wood fibers from wicking up too much stain.

You also get uneven results by stretching a sanding disc or sheet beyond its useful life, like the bare 80-grit disc shown at *left*. How long a piece of coated abrasive paper lasts depends partly on the type of abrasive grit you're using. Different grit materials degrade in different ways. Garnet paper, for example, breaks down faster than most other types of grit, although its granules fracture into smaller cutting edges instead of losing their effectiveness by becoming blunted. That makes it the least durable material, but also the least expensive. The most durable types of sandpaper use silicon carbide or ceramic alumina grit. Alumina zirconia grit holds up longer than garnet, making it a durable choice for sanding belts. For more information about different types of sandpaper and their uses, see the chart *below*.

When using a fresh sheet, resist the urge to press down on your sander. Instead, let the fresh cutting edges of the granules do their work. When it feels like the newness has worn off of the paper, check for buildup and press down lightly as you sand. Once you sense that you have to press down firmly to get any results at all, change sheets or discs and throw the old ones away.

Sand by the Numbers

Tempted to skip grits and save time on a large project? Don't. When you skip from 150 grit to 220 grit, bypassing the 180-grit stage, you're expecting a fine sandpaper to remove coarse scratches. It'll do the job eventually, but you'll spend far more time to do the job. The typical range of grits to keep on hand are as follows: 80, 100, 120, 150, 180, 220 or 240, 320, and 400 grit.

For rough surfaces with noticeable tool marks, start as low as 80 grit, especially in places where you're sanding by hand. Well-tuned machinery that leaves smoother surfaces—coupled with the aggressive cutting speed of a random-orbit sander—lets you jump ahead to 120 or even 150 grit. Stop at 180 grit for unstained surfaces, or proceed up to 220 grit for surfaces to be stained.

Time-saving tip: If these stopping points seem low, you may be oversanding. Polishing bare wood up to 400 or 600 grit

Use the right abrasive for the job

	Aluminum Oxide	**Alumina Zirconia**	**Garnet**	**Ceramic Alumina**	**Silicon Carbide**
Description	Made from abrasive-grade bauxite, it has a high density and resists fracturing more than garnet	A mix of aluminum and zirconium, this grit removes wood quickly; granules self-sharpen	Made of brittle silicate crystals and grains, garnet fractures to produce fresh, though smaller, cutting surfaces; wears quickly	Aluminum oxide that's coated and then fired in a kiln; aggressive grit cuts faster than regular aluminum oxide	Hard, sharp grains cut faster than any other grain; frequently used to finish metals; available in extremely fine grits (1000-grit and finer)
Uses	General purpose sanding of wood or metal; most commonly used grit material	General purpose sanding of wood or metal where durability is important	Finish sanding of wood, especially in higher grits	General purpose sanding of wood or metal where maximum durability is needed	Suitable for wood, surface finishes, metals and plastics; can be used wet or dry
Costs*	$.35/sheet (paper), $.95/sheet (cloth)	$2.13/3×21" belt	$.25/sheet (paper)	$.99/sheet	$.63/sheet (paper)

* Prices are estimates. Actual prices vary with vendor, brand, and quantity purchased.

Contour pads allow you to divide complex profiles into sandable surfaces. These are from Lee Valley Tool (800/871-8158 or leevalley.com; item #68Z82.10).

Potential stain problems can't hide from this trick. Swipe sanded surfaces with mineral spirits to highlight blemishes or under-sanded spots that stain might reveal.

doesn't necessarily yield a smoother surface for anything other than an oil finish. That's because you see and touch film-forming finishes, not the wood itself. So take the time you used to spend sanding bare wood and devote it to rubbing out your varnish or polyurethane topcoat. That's a difference you'll notice.

Edges, round parts, and detail work require you to slow down. Switch to hand-sanding with an assortment of contour pads in the shapes that will reach into and around complex curves and angles, as shown *above*.

Whether you're power-sanding or working by hand, thoroughly cleaning off the old grit at the end of each stage will spare you time wasted on sanding do-overs. Coarser grits can contaminate your sanding surface and leave new deep scratches even as your finer grits remove the previous layer of scratches.

Removing sanding grit and dust with compressed air also blows dust out of the wood pores, but it makes a mess of your shop. To control dust levels, vacuum the surface with a soft brush attachment that dislodges debris from the surface. Even a fine-bristle brush alone does the job if you're sanding outdoors. Tack rags still work well, but their oily contents need to be used with care if you'll be applying a water-based stain or finish.

A clean wood surface also can be damaged by bits of loose, coarse grit if you're careless with how you handle your sander. Lay sanders on their side and sandpaper face up on a workbench to avoid picking up grit from earlier sanding work. If you vacuum your work between grits, vacuum your workbench as well and shake out sanding mats.

Finish Your Finish

Once your bare wood reaches ready-to-finish smoothness, sanding abrasives still have a role to play.

If you intend to use a water-based finish, prepare the wood by raising and flattening the grain. Moisten a rag with water and wipe the surface to stand the loose wood fibers on end where they can be knocked off with sandpaper that's one grit beyond the last grit you used.

Time-saving tip: Just a couple of light passes will knock off nibs raised by moistening wood. Sanding too much exposes a new fresh layer of wood with a new batch of nibs that need to be wetted and removed. For oil-based finishes, go directly from your final sanding to finishing.

Time-saving tip: As with sanding the raised grain on bare wood, a light touch with 240- or 320-grit paper is all you need after using a seal coat and to sand between coats of finish. Sanding too hard or too long cuts through the seal coat and into the bare wood or stain. Measure your sanding time in seconds, not minutes. One or two light passes by hand usually does the trick.

Once your seal coat has dried, it may still be rough enough that you can apply a second coat without sanding first. That's another precaution against oversanding.

You sand between coats not to create a smooth surface so much as to create a rough one. Lacquers and shellac don't require between-coat sanding because each coat partially dissolves and bonds with the previous coat. Finishes like polyurethane and varnish don't bond with the smooth surfaces each coat creates. So between coats, scuff-sand the surface just enough for the new coat to form a mechanical bond with the previous coat. Again, easy does it with the sander.

Written by **Bob Wilson**
Illustration: **Mike Mittermeier**

SHOP TIP

File under "S" for simple sanding storage system

There are lots of ways to organize stray pieces of sandpaper, but few save money and space like these multi-pocket accordion folders. We labeled the pockets to store 80- through 1,000-grit sheets and discs. The blue folder holds wet-dry paper while red one stores dry coated abrasives. The pair cost less than $20 from an office supply store.

Get the most from your tool batteries

12 essential truths about the power plants that drive today's cordless tools

The number of individual cells in a battery pack determines its voltage. This pack has thirteen 1.2-volt cells on the bottom tier, and two on the top tier, for a total of 18 volts.

Some of us were slow to jump on the cordless tool bandwagon; but once we got on board, there was no turning back. Cordless tools, especially drills, now have ample power to perform almost any task as well as their corded counterparts. The only real remaining frustration is that sometimes battery packs wilt away into uselessness, and the old corded version has to be dusted off and resurrected to finish a job. However, knowing the following essential truths will help you squeeze the most life from your battery packs before they have to be recycled.

Shop for a tool with a quality battery system

Except for voltage and price, manufacturers usually don't offer much information on the tool's packaging to help make a buying decision. Published tool tests and online tool retailers usually offer more specifics about a tool's battery pack and charger.

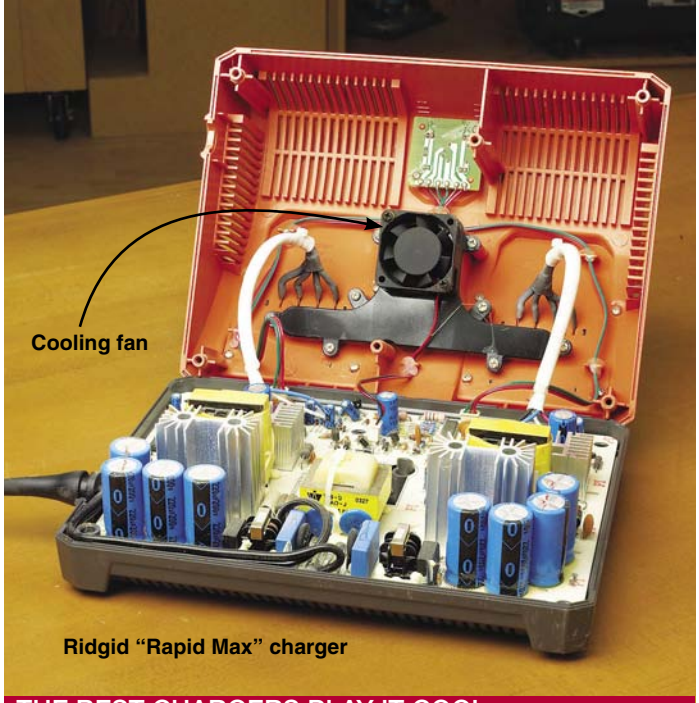
Truth 1: You can't tell quality from specs. Like a horsepower rating for a car engine, voltage measures available power and merely indicates the number of cells in a battery pack, as shown in the photo, *above*. Amp-hour (Ah) ratings measure battery-pack capacity in the same way that gas-tank size and miles-per-gallon measure a car's driving range. Neither number offers information about how those cells were made or joined together.

Truth 2: Buy a tool with a "smart" charger that determines when a battery pack is cool enough to safely accept a charge and shuts off when the charge is complete. Chargers with temperature sensors will have three or more contacts instead of two. Some chargers, such as the one shown *next page, top left*, provide their own cooling system to optimize charging and battery life.

Truth 3: Cost and quality tend to go together. Nearly half a cordless tool's cost is in its battery pack. Because the cordless tool market is extremely competitive, higher cost is usually associated with more expensive technology used to create the tool, charger, and battery pack.

Using and maintaining battery packs

Regrettably, all rechargeable battery packs have a shelf life and will eventually quit accepting a charge. A battery pack typically lasts three to five years, but you also can define a battery's life in terms of cycles and use. Consequently, a frequently and heavily used battery pack may not last even two



Ridgid "Rapid Max" charger

THE BEST CHARGERS PLAY IT COOL

Heat is your battery's No. 1 enemy, and this charger's built-in fan cools the battery before and during charging. Its complex electronics monitor the battery condition while topping off the battery's tank.

SOME CHARGERS KNOW HOW, WHEN TO CHARGE

Diagnostic ("smart") chargers display battery conditions and charging status with LED indicator lights that flash in different sequences. You can crack the code with instructions posted on the charger's label.

years. However, good battery maintenance habits will help ensure that you don't artificially shorten a pack's useful life.

Truth 4: Batteries need exercise, not exhaustion. Routinely using a battery until it's completely drained eventually will damage the pack and can reverse the polarity on one or more cells, causing the pack to quickly fail. As a rule of thumb, when you first notice the motor slowing, recharge the pack.

Truth 5: Don't charge a hot battery unless you have a smart charger with a temperature sensor. (See photo *above*.) A hot battery will not readily accept a charge and can be damaged if it's forced. If your charger has neither a temperature sensor nor auto shut-off feature, allow the battery to cool to room temperature before charging and remove it before it gets hot. If it's having trouble accepting a charge, a pack will heat up even more, causing further damage.

Truth 6: Don't use a low-voltage tool for a high-voltage job. While a 12-volt drill can drive a lag or a 2" Forstner bit, it won't do it for long and could damage the battery. Use lower voltage tools for light- and medium-duty repetitive tasks. Use higher voltage or corded tools for heavy-duty tasks.

Truth 7: Avoid extreme temperatures when storing battery packs or during extended periods of use. If you live in an area with an extreme climate, hot or cold, store your battery packs in a cool, dry space such as a basement.

Mythbusters: Conventional wisdom isn't always right

The technology behind rechargeable batteries has improved and changed dramatically in the last few decades. Unfortunately, some myths about rechargeable batteries remain as durable as ever. Let's debunk those myths.

Truth 8: There's no such thing as "battery memory." Even battery stores perpetuate this myth. Bad habits damage good batteries, and cheap production techniques result in low-quality batteries. Both get confused with memory effect.

Truth 9: Freezing a dead battery won't "shock" it back to life. Freezing causes the electrolyte inside the battery cells to begin to crystallize, damaging them. When you have a battery pack that's not performing as well as it should, drain it completely (use the flashlight tool) and run it through several complete charge/discharge cycles.

Truth 10: Rebuilding your own battery packs won't save you time or money. Replacing a single cell is a fool's errand. While some battery stores will replace all the cells in a pack, the chemical recipe of the replacement batteries will not likely match the charging profile of the charger that came with the pack.

Truth 11: Nickel-metal Hydride (NiMH) batteries aren't necessarily better than Nickel Cadmium (NiCd). Both chemistries are good for different applications. Although NiCd technology offers a lower amp-hour rating (2.4 Ah is the max), the battery packs can work through more charge/discharge cycles (about 700, compared to about 500 cycles for NiMH). If long run time is a primary concern, NiMH has a top Ah rating of 3.5; however, less-durable technology is used to achieve the highest ratings, so NiMH batteries generally don't function as well in extreme temperatures and hard-use conditions.

Truth 12: Don't charge NiCd batteries in a charger designed for NiMH (or vise versa), unless the manufacturer specifically states that you can do so. The battery chemistries require different charging protocols designed to optimize battery performance. Chargers that work with both types of batteries recognize the battery chemistry and use the appropriate protocol.

Written by **Mike Satterwhite** with **Dave Campbell**

When good batteries go bad

Manufacturers define a "bad" battery pack as one that achieves 60 percent or less of its rated capacity after a recharge. Yet your own definition may not be quite as rigid. When a battery pack is not performing to your satisfaction, buy a replacement pack.

Don't trash the old pack! It may contain environmentally damaging heavy metals. Instead drop it off at a major retailer, such as The Home Depot, Sears, Best Buy, Target, or Circuit City. These retailers—and many others—accept worn out batteries on behalf of the Rechargeable Battery Recycling Corporation. For the nearest drop-off location, call RBRC at 800/822-8837 or visit www.RBRC.org.

turn bargain boards into

Test samples of dyes and stains on different species of wood will help you gauge just the right combination to make a perfect match.

Whether for savings or convenience, sometimes you need alternatives to premium-priced hardwoods.

Judging by their price, some hardwoods should be displayed in a glass case like fine jewelry. By making either entire projects or just inconspicuous parts from low-cost species instead of the real deal, you can lower your project costs without sacrificing looks or quality.

Turn willow into walnut

Why willow? Willow lacks walnut's density and durability, but the heartwood of carefully selected pieces approximates the color and grain patterns of walnut.

Making the switch: Willow pieces with a close color match to walnut require little or no staining. Willow soaks up liquid stain faster than less porous walnut. If you plan to mix walnut and willow in a project and will be staining both, first experiment on scraps of both species with different types of stains. Gel stains will produce less blotching on willow.

Turn birch into maple

Why birch? Birch imitates maple's pale creamy color and nonporous grain. Many home centers stock birch as lumber, plywood, or both, making it one of the most readily available woods.

Making the switch: To ensure a good color match, take a sample of maple to the store as you pick out your birch stock. Birch veneer plywood and Baltic birch plywood provide alternatives to solid birch. Both maple and birch will retain their light color when left natural and coated with lacquer or water-based coatings.

luxury lumber

Furniture makers have mixed and matched wood species for centuries, and you can do the same. Many substitutions—swapping birch for maple, for example—require no added effort. Other replacements require only applications of stain or dye.

To start saving money with low-cost woods, first identify the bargain species in your area. One region's budget board may carry a premium price elsewhere. A store near our Des Moines office sells willow for $2.19 a board foot. From his home in Texas, our finishing consultant Jim Kull says willow costs roughly four times that much.

Now compare the grain patterns of less expensive species with the patterns of premium woods. The reason willow can mimic walnut but pine can't boils down to grain patterns. Here are the three types of hardwood grains:

- Open-pore woods, such as oak and ash.
- Medium-grain woods, which include walnut and mahogany.
- Closed-grain woods, such as maple, beech, and cherry.

Once you find inexpensive lumber with grain resembling costlier wood, consider the two main wood coloring options:

■ **Stains.** These often have a pigment to color wood, although some combine a pigment with a dye. You can spot these because the pigment settles to the bottom of an undisturbed can. Commercial stains yield predictable results and some products effectively highlight the grains of open-pore and medium-grain woods. Stain pigments are more colorfast than dyes. On cherry, pine, and other woods where blotching is a concern, gel stains create a more uniform color than liquid stains.

■ **Dyes.** Wood dyes produce even colors by tinting the individual wood cells without depositing pigment on the surface. In addition to standard colors, different dyes are easy to combine for custom colors. A damp cloth can lighten water-based dyes, even after they've dried. However, water-based dyes raise wood grain and you lose some of the color by sanding off the nubs. Alternatives to water-based dyes include alcohol-based and nongrain-raising (NGR) dyes. Also, few retailers carry dyes, so you'll likely need to rely on mail-order suppliers, such as those listed in Sources on the *next page*.

Turn lauan into mahogany

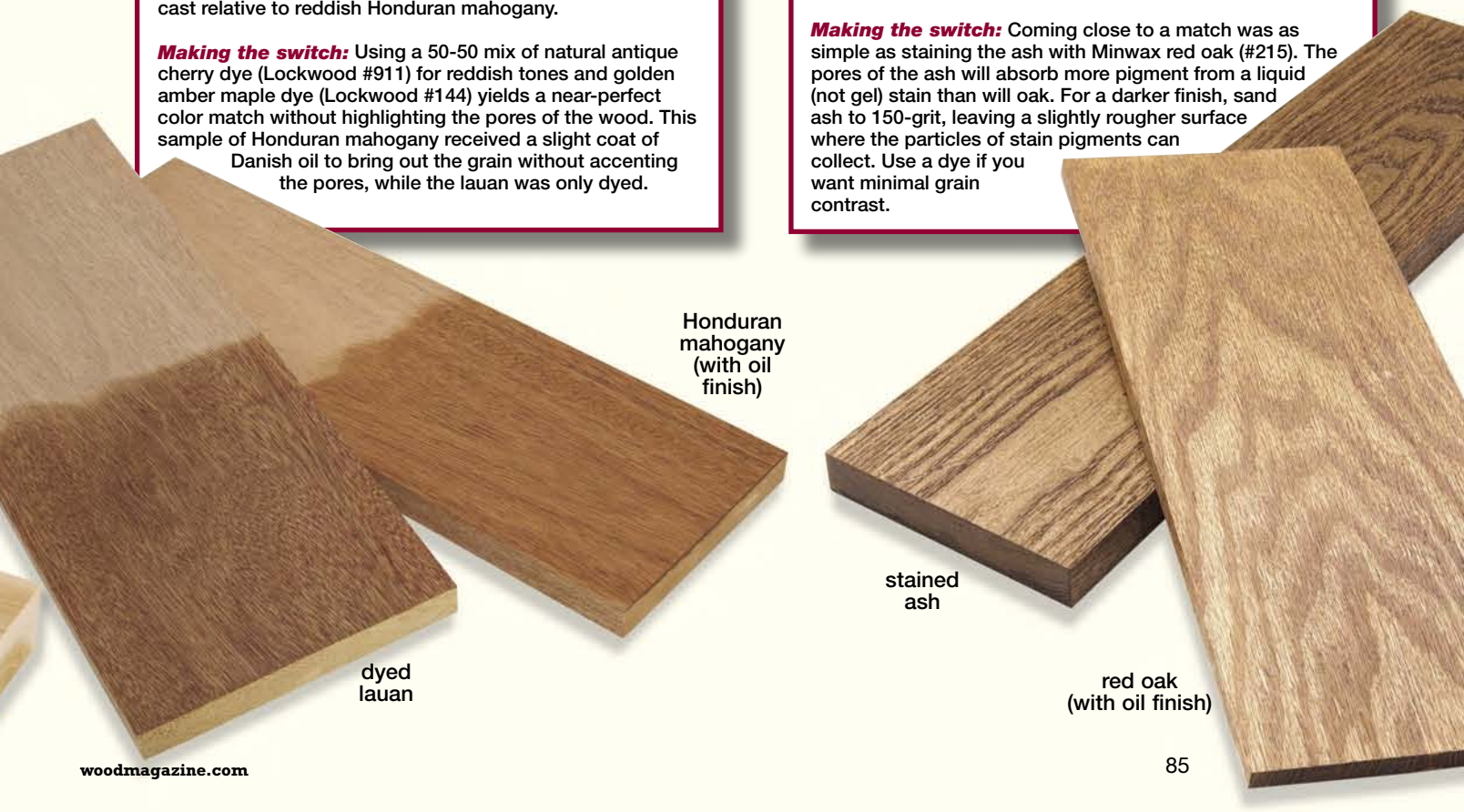
Why lauan? From hollow-core doors to furniture, lauan (also called Philippine mahogany) has long been substituted for more expensive Honduran mahogany because it has similar color and grain pattern. Lauan can have a slight gray cast relative to reddish Honduran mahogany.

Making the switch: Using a 50-50 mix of natural antique cherry dye (Lockwood #911) for reddish tones and golden amber maple dye (Lockwood #144) yields a near-perfect color match without highlighting the pores of the wood. This sample of Honduran mahogany received a slight coat of Danish oil to bring out the grain without accenting the pores, while the lauan was only dyed.

Turn ash into oak

Why ash? Few woods match the dramatic grain pattern of flatsawn oak, but ash comes close. Stain containing pigment catches in the pores of both ash and oak, emphasizing their similarities further.

Making the switch: Coming close to a match was as simple as staining the ash with Minwax red oak (#215). The pores of the ash will absorb more pigment from a liquid (not gel) stain than will oak. For a darker finish, sand ash to 150-grit, leaving a slightly rougher surface where the particles of stain pigments can collect. Use a dye if you want minimal grain contrast.



Making a match

Whether you stain or dye woods to match their luxury counterparts, what you actually copy is the finished look, not the raw wood. When matching woods, you may feel as if you're aiming at a moving target because machining, stains, and topcoats dramatically alter a hardwood's appearance, even for the most simple finishes.

While altering inexpensive lumber, compare each stage of your color-matching process to a finished sample of the wood you're imitating. Many of the examples shown here aim to match either the more expensive wood's natural appearance or the lightest possible finish because those can be the most difficult to achieve. Practice fine-tuning your matches using the tips listed in "9 Tips for Matching Woods" at *right*.

Sources

Dye. W.D. Lockwood & Company, 866/293-8913 or wdlockwood.com

Gel stain. Bartley brown mahogany gel stain, 800/787-2800 or bartleycollection.com

9 tips for matching woods

1 Sanding affects staining. Sanding to higher than 180- or 220-grit leaves fewer scratches where stain pigments can collect, producing lighter colors. Sanding affects dye color variations less because dyes penetrate the cells of the wood instead of leaving pigment on the surface. Spot rubbing with steel wool also lets you fine-tune stains and dyes.

2 Match wood colors as you match grain texture. Woods of the same species vary in color, and not just between heartwood and sapwood. Take the time to match both color and grain between premium and bargain woods, and you'll spend less time on finishing.

3 Make custom mixes in bulk. You're better off making extra quantities of custom stain or dye mixes than trying to reproduce something you used up.

4 What's in a name? Not much, as you can see from some of the stains and dyes we used to make our sample boards. If the label says "medium amber maple" but the dye turns your Lyptus into a convincing imitation of walnut, remember that results, not names, are what counts.

5 Make samples. Recycle bargain wood scraps from past projects, and finish them with dyes or stains in your workshop, as shown *top left on page 84*. Write down the products you used, and then cover the sample with a clear spray finish. You'll save the trial-and-error time you spend making the same discoveries twice.

6 Tint plywood with care. Hardwood veneers on plywoods are extremely thin and will soak up more stain than sawn lumber. Thin colored stain with a natural finish stain product, and start light as you experiment on scrap pieces.

7 Take notes as you experiment. Nothing matches the frustration of being unable to reproduce that perfect shade you achieved by mixing two or more stains or dyes. Record formulas as proportions—four measures of maple stain to one of cherry, for

Turn maple into ebony

Why maple? If your project needs a touch of the exotic that your budget can't bear, choose maple for its density and closed-pore grain.

Making the switch: The fine pigments in India ink produce a deep, dark, and consistent black, even on the dense surface of maple. Before coloring the wood, cut and shape parts to size. Then finish-sand all surfaces, taking the end grain to at least 320-grit prior to staining.

Turn Lyptus into mahogany

Why Lyptus? An attractive wood in its own right, Lyptus is becoming easier to find in the United States as plantations where it's grown have increased their production.

Making the switch: Lyptus is a dense, light-color wood that seems to repel liquid stains. To color Lyptus without excessively highlighting the pores of the wood, we used a walnut dye (Lockwood #99). This works best for matches where the mahogany grain is highlighted with a light stain, such as a coat of light walnut Danish oil.

example—so you can increase quantities without losing color balance.

8 Nothing lasts forever. Don't worry if your color matches are slightly less than perfect. Woods lighten or darken with age and exposure to sunlight, while water-based dyes lose some of their colorfastness. Not even nature makes all lumber within a species the same color, so don't feel as though you should.

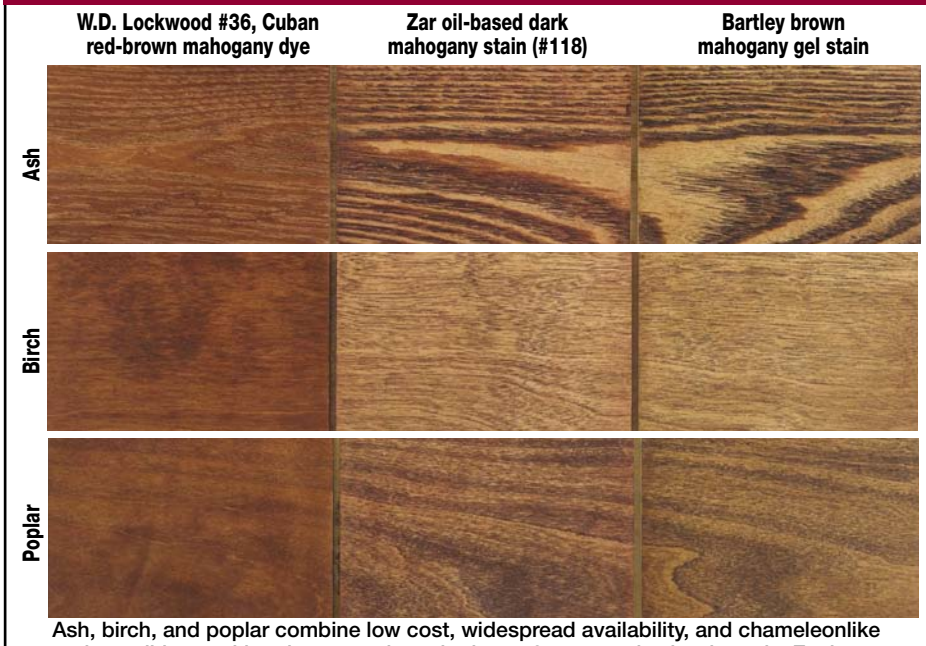
9 Experiment with the unusual. We used India ink to simulate ebony. Wood finishing specialist Jim Kull uses another trick: Have a paint dealer add pigments for a particular color chip to an empty can. Then mix the pigments with water to create a custom-color stain.

Learn more

wood-finishing techniques at

woodmagazine.com/finishes

How 3 dyes and stains affect 3 popular substitutes



Ash, birch, and poplar combine low cost, widespread availability, and chameleonlike grain qualities, making them popular substitutes for expensive hardwoods. Each reacts differently to dyes and stains, however, so we prepared this comparison using three products that show how the word "mahogany" can translate into many shades.

Turn poplar into cherry

Why poplar? Widespread availability and low prices make poplar a prime substitute for more expensive woods. Avoid poplar boards with a greenish cast or strong color contrasts between the heartwood and sapwood.

Making the switch: Dye will provide consistent color and, because it's water-based, a damp rag can extract some of the excess if you use too much. (We used Lockwood #911 natural antique cherry dye for this sample.) Allow a little extra shading for the light sanding needed to remove wood fibers raised by water-based dyes. Like cherry, poplar tends to blotch. To make spot adjustments to the color, lightly rub darkened areas with 320-grit sandpaper.

Turn Lyptus into walnut

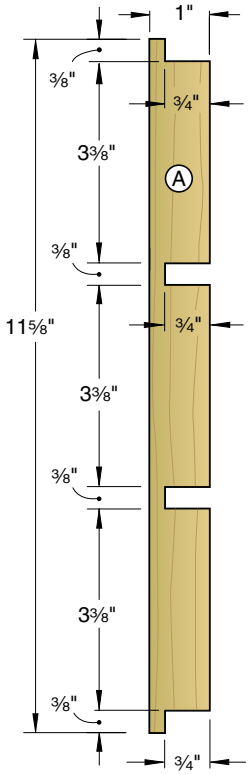
Why Lyptus? Any tint that reaches into and accents the pores in Lyptus will imitate the grain qualities of walnut. Unlike willow, Lyptus also offers a density comparable to that of walnut.

Making the switch: We applied antique mahogany dye (Lockwood #110) over an application of medium amber maple dye (Lockwood #143) for the multicolor shadings commonly seen in walnut.

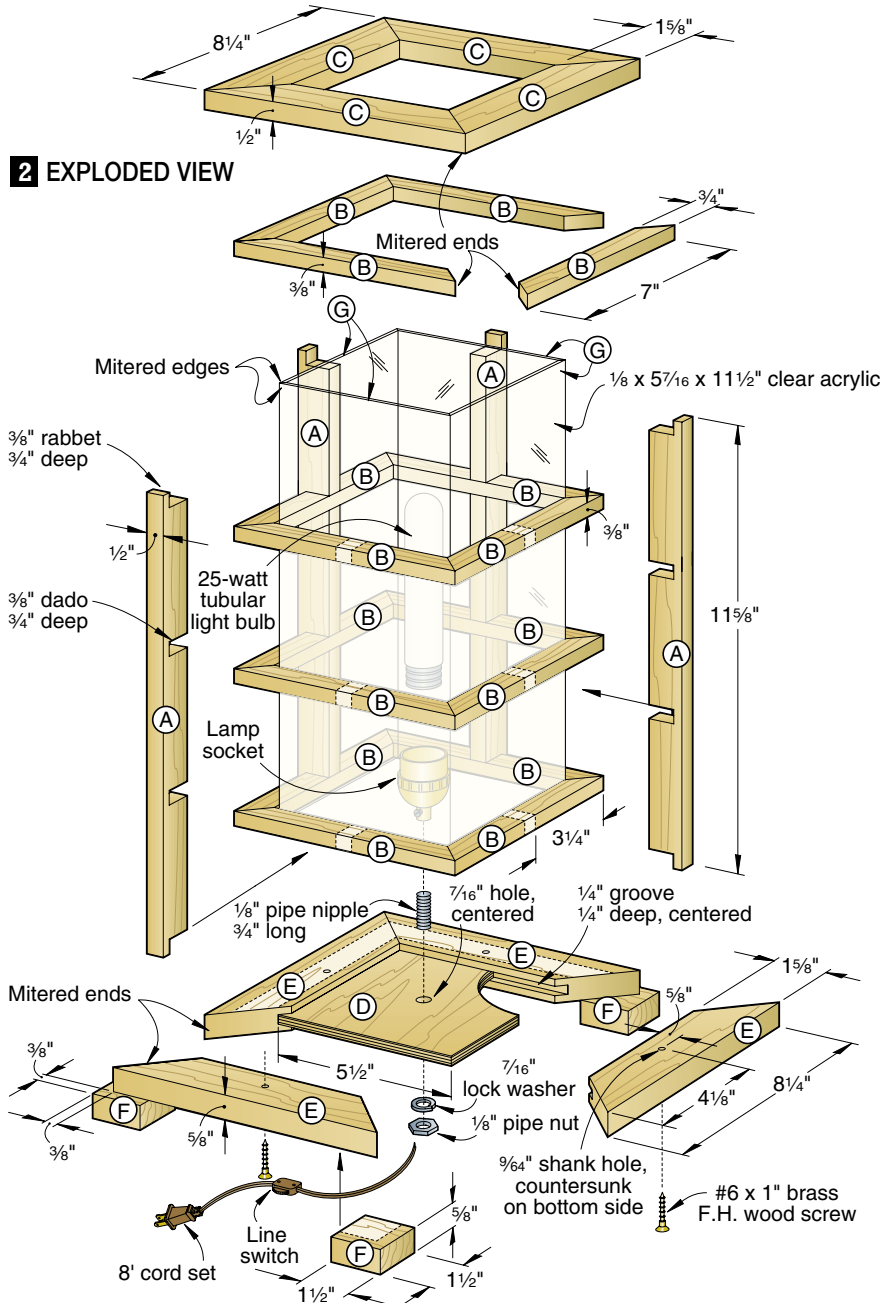
warm-glow accent lamp

A surprisingly simple-to-make acrylic diffuser is the key to this walnut-framed beauty.

1 UPRIGHT



2 EXPLODED VIEW



A small investment in time and materials makes a big payoff when this weekend project brightens a spot in your home. The acrylic for the diffuser and all the lamp hardware are conveniently available at home centers or hardware stores. And just in case you don't own a planer, we provide a source for a preplaned lumber kit. (See *page 90*.)

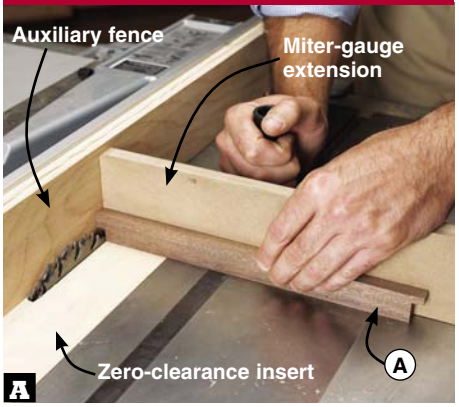
Start with the lantern

1 From ½"-thick stock, cut the uprights (A) to the size listed on the **Materials List**. Install a ⅜" dado blade in your tablesaw and cut rabbets in the ends, where dimensioned on **Drawing 1** and as shown in **Photo A**. Then reposition the fence for a stop, and cut the dadoes where shown. Finish-sand the uprights.

2 Plane stock to ⅜" thick for the frame sides (B), checking it for a snug fit in the upright (A) dadoes. Then cut the frame sides to size and miter the ends, where shown on **Drawing 2**. Assemble the four frames, as shown in **Photo B**. Remove excess glue, and make sure the frames are flat and square. With the glue dry, remove the tape and finish-sand the frames.

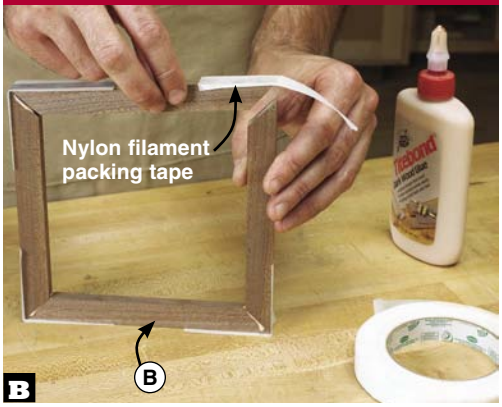
3 Assemble the lantern, as shown in **Photos C** and **D**. To prevent squeeze-out, apply

SET UP FOR CLEAN CUTS



With a ⅜" dado blade grazing an auxiliary fence and a miter-gauge extension and zero-clearance insert to eliminate chip-out, cut the end rabbets in the uprights (A).

TAPE CORNERS FOR TIGHT MITERS



Use nylon filament packing tape to fasten four frame sides (B) together tip to tip. Apply glue to the miters, fold the sides into a square, and tape the open corner.

the glue sparingly. See the **Shop Tip**, *below*, for an inexpensive glue-up helper.

4 From ½"-thick stock, cut the cap sides (C) to size. Miter the ends and tape and glue the cap frame together, as you did with the other lantern frames. Finish-sand the cap frame. Then glue and clamp it, centered, to the lantern top frame, where shown on **Drawing 2**.

Now make the base

1 Cut the base panel (D) to size. Draw diagonals to find the center, and drill a 7/16" hole, where shown on **Drawing 2**.

2 Plane a ¾×3½×22" piece of stock to ⅝" thick for the base sides (E) and feet (F), and cut the parts to size. Cut ¼"-deep centered grooves to match the thickness of the base panel (D) in the inside edges of the base sides, and then miter the ends.

3 Apply glue in the base side (E) grooves and clamp them to the base panel (D). With the glue dry, drill 9/64" shank holes through the base sides, countersunk on the bottom face, where shown on **Drawing 2**. Finish-sand the base frame and feet (F). Then glue the feet to the base frame.

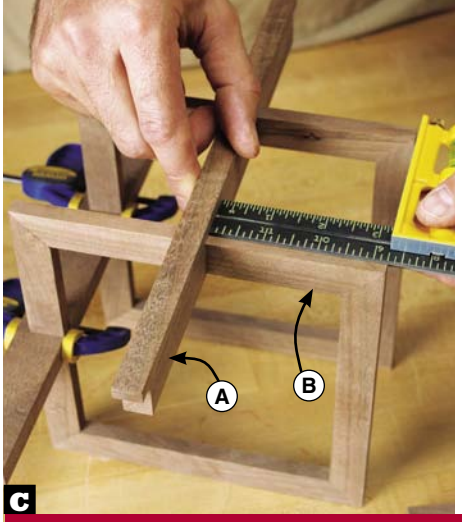
4 Place the lantern frame (A/B/C) upside down on your workbench, center the base (D/E/F) on it, and clamp the base in place. Using the countersunk shank holes in the base sides (E) as guides, drill 3/32" pilot holes ⅜" deep into the bottom frame sides (B). Remove the base from the lantern, marking one set of shank and pilot holes for proper reassembly.

5 To make the diffuser from ⅛" clear acrylic, see *page 20*.

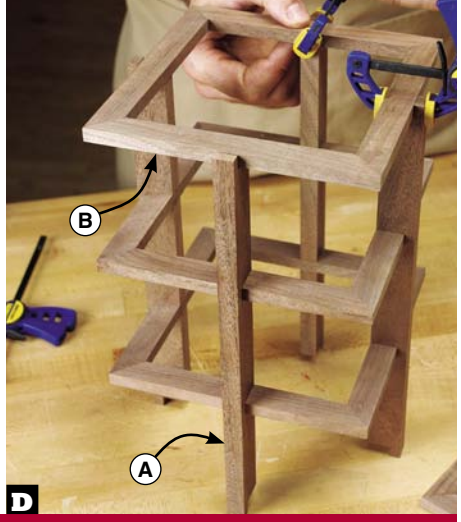
SHOP TIP

Apply glue with pinpoint accuracy

A glue injector, available from woodworking specialty stores and mail-order catalogs, makes it easy to place the right amount of glue exactly where you want it.



C



D

ASSEMBLE THE LANTERN IN TWO EASY STEPS

Apply glue to the dadoes in the uprights (A). Then centering the uprights on the sides of two of the frames, clamp them in place.

Apply glue to the rabbets in the uprights (A). Center the uprights on the sides of the top and bottom frames and clamp them in place.

Apply finish and assemble

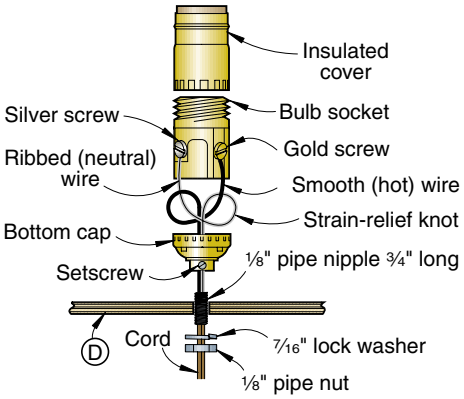
1 Examine the lantern and base, and resand any areas that need it. Apply a clear finish. (We sprayed on three coats of aerosol satin lacquer, sanding between coats with 320-grit sandpaper.)

2 Referring to **Drawing 3**, snap the lamp socket shell apart, thread a ¾"-long pipe nipple into the bottom cap, and secure it with the setscrew. Insert the pipe nipple into the hole in the base panel (D) and secure it with a lock washer and pipe nut. Push the end of the cord set (we bought ours with a line switch already installed) through the pipe nipple, tie a strain-relief knot in the cord, and fasten the ends to the bulb socket. Snap the shell together.

3 Place the lantern frame upside down on your workbench and slide in the diffuser. Center the base on the lantern frame aligning the marked screw holes and drive the screws. Turn the lamp right side up and install a tubular lightbulb. Now find a dim corner that needs cheering up, and put your lamp to work.

Written by **Jan Svec** with **Chuck Hedlund**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine**

3 WIRING DIAGRAM



Materials List

Part		FINISHED SIZE T	W	L	Matl.	Qty.
A	uprights	½"	1"	11⅝"	W	4
B	frame sides	⅜"	¾"	7"	W	16
C	cap sides	½"	1⅝"	8¼"	W	4
D	base panel	¼"	5½"	5½"	P	1
E*	base sides	⅝"	1⅝"	8¼"	W	4
F*	feet	⅝"	1½"	1½"	W	4
G*	diffuser sides	⅛"	5 7/16"	11½"	A	4

*Parts initially cut oversize. See the instructions.

Materials key: W–walnut, P–plywood, A–acrylic.

Supplies: #6×1" brass flathead wood screws (4), 8' cord set with line switch, ⅛" pipe nut, 7/16" lock washer, ⅛" pipe nipple ¾" long, lamp socket, 25-watt tubular lightbulb, ⅛×18×24" acrylic, gap-filling instant (cyanoacrylate) glue.

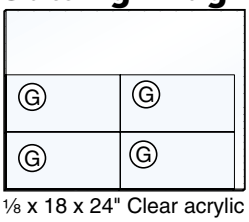
Blade: Stack dado set.

Sources

Glue injector. 15cc injector with a 3" barrel no. 50468, $.69 ea., or 10 or more for $.62 ea.; 30cc injector with a 3½" barrel no. 50476, $.99 ea., or 10 or more for $.89 ea. Rockler Woodworking and Hardware. Call 800/279-4441, or go to rockler.com.

Wood and acrylic kit. ¼" plywood, walnut planed to the finished thicknesses for the parts listed *above*, four ⅛×5¾×11½" pieces of clear acrylic for the diffuser sides. Order kit no. W-161 and indicate one of the following quantities: one lamp, $25.95 ppd., two lamps, $47.95 ppd., five lamps, $109.95 ppd. Heritage Building Specialties. Call 800/524-4184, or go to heritagewood.com.

Cutting Diagram



⅛ x 18 x 24" Clear acrylic

¼ x 5½ x 5½" Plywood

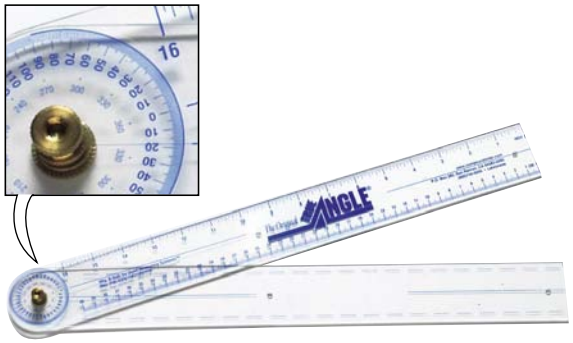
¾ x 3½ x 96" Walnut (2.7 bd. ft.) *Plane or resaw to the thicknesses listed in the Materials List.

our editors test angle finders

Why buy?

Woodworkers have dozens of accessories and jigs available to help make perfectly square cuts. It's the other angles that get us into trouble. For example, if a mitered corner is just a degree or two off it can ruin a project. The devices shown here help you measure and transfer an angle precisely to your workpiece, mitersaw, or tablesaw miter gauge. Some are more helpful than others, as you'll see, and all are worthy of your shop.

True Angle, $16



Editor test-drive:

True Angle's advantages are its size (I tested the 18" version; there are models from 7" to 6' long), low price, and the accuracy of its scale. The 360° scale is only 2" in diameter, but its crisp, fine markings gave my bifocals less trouble than I expected.

I used True Angle to measure an oddly angled bump-out in my house for crown molding. It's a bit of a circus act to hold the flexible legs against two walls while tightening the lock nut. And, once done, I had to handle the True Angle carefully to prevent changing the angle before I could read the scale. But after miter-cutting the molding to half that angle, I found that the pieces mated nicely.

If I were doing any amount of molding work, I'd probably spring for the "Crown Molding & Trim Kit" ($40) that includes 7" and 18" True Angles and a book about installing molding.

—Tested by Bob Wilson, Techniques Editor

To learn more:
866/544-2016, compoundmiter.com

ProSite Protractor No. 505A, $60

Editor test-drive:

This beautifully machined aluminum angle finder has dual scales around its pivot point: The black scale shows the actual angle being measured (if you were cutting only one piece to mate); the red scale shows the angle to set your mitersaw for a mitered joint. Friction alone holds the angle setting, and holds it well.

Another nice no-calculate feature of the ProSite Protractor is that the 360° scale is marked in four 0–90° increments, so the cutting angle transfers to your mitersaw settings without a lot of mental gymnastics. I used the ProSite Protractor for fitting drawers into angle-front kitchen cabinets, rebuilding wooden parts for a Model T I'm restoring, and installing base molding. In every case, mating parts fit together perfectly.

The 12"-long legs (I'd like to also see a shorter version for tight spots) are ¼" thick, so the ProSite Protractor can be used to transfer angles like a sliding bevel or try-square, with one leg against the edge of a workpiece while the other lies on the adjacent face.

—Tested by Chuck Hedlund, Master Craftsman

To learn more:
800/772-3649, starrett.com

Bosch Miter Finder, $120

Editor test-drive:

Forget about reading tiny little hash marks on a scale: Bosch's Miter Finder shows the angle (from 0° to 223°, accurate to 1/10°) in bold LCD digital displays on both sides of the tool. The heavy-gauge aluminum construction makes it lightweight yet durable.

Miter Finder really shines when it comes to cutting crown molding, thanks to its built-in calculator. The corners in a house are rarely square, rendering those special miter and bevel markings on your mitersaw scales useless. Use Miter Finder to first measure the angle between the wall and ceiling, and then the one between the adjacent walls, and this tool automatically figures the correct miter and bevel angles for your mitersaw. I had no trouble making crown molding joints match up flawlessly.

In general shop use, I found the Miter Finder equally indispensable for measuring and transferring angles, but its size (17" long) made it a bit cumbersome for smaller workpieces. I'd love to see a smaller version with fixed stops at 45° and 90°.

—Tested by Kevin Boyle, Senior Design Editor

To learn more:
877/267-2499, boschtools.com

These woodworking wares passed our shop trials.

Spray a fine finish—with little overspray—for about $120

When it comes to spraying finish on a project, I prefer a high-volume, low-pressure (HVLP) system. Compared to conventional spray guns that leave a cloud of finish floating around the shop, most of the product sprayed by an HVLP system stays on the project. That saves you money by getting more finish on your project and less on, well, everything else.

You can buy HVLP conversion guns that hook up to an air compressor, but you need a 3- to 5-hp compressor to keep up with the demand for air. An HVLP turbine system, on the other hand, pumps filtered shop air through a large-diameter hose, making it both self-contained and more expensive—sometimes hundreds of dollars more—than a conversion gun.

Now Wagner Spray Tech comes along with the Fine Spray 2400—a turbine-powered HVLP system selling for about $120. At this low price, I didn't expect much, but I was surprisingly satisfied with the results I got spraying light-bodied materials, such as oil- and water-based stains. (Unlike more-expensive HVLP turbine systems, the Fine Spray 2400 isn't designed to shoot heavy liquids, such as latex paint.)

I shot unthinned oil- and water-based urethanes easily, and the Fine Spray 2400 left a smooth finish. Some heavy-bodied finishes may need to be thinned; Wagner includes a viscosity cup to tell you when a material is thin enough to spray.

The spray tip rotates to lay down a round, horizontal, or vertical spray pattern from 2" to 12" wide. I also liked the user-friendly knob on the back of the gun that regulates the flow of finish coming out. (Turn toward the + sign for more material, to the – sign for less.) Setup and cleanup are simple and intuitive, reducing the intimidation factor for first-time sprayers.

So, what are the downsides? Few, actually. The Fine Spray's 20' hose is a bit stiff to stand up to potential crushing from accidental footfalls. That stiffness and the absence of a swivel where the hose connects to the gun make the system a bit unwieldy at times. And, like most turbine HVLP systems, the turbine unit makes about as much noise as a shop vacuum.

—Tested by Pat Lowry

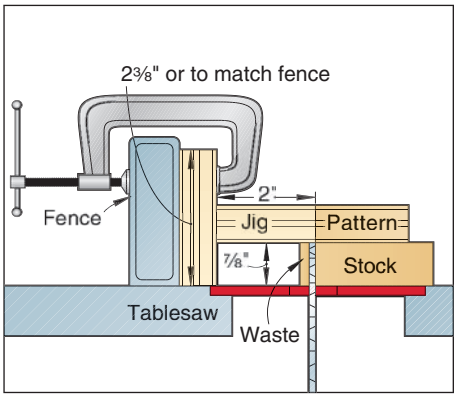
Fine Spray 2400 HVLP System

Performance	★★★★☆
Price	$120

Wagner Spray Tech
800/328-8251; wagnerspraytech.com

ask wood

Answers to your questions from letters, e-mails, and WOOD Online®



Attach a jig, like the one shown, to your tablesaw's rip fence to easily duplicate parts. Re-use the patterns as often as needed to complete the project.

Tablesaw pattern jig

Q: I'm making Adirondack chairs that have tapered rip cuts on a number of pieces. Can I make these cuts at the tablesaw?

—Brad Johnson, St. Paul, Minn.

A: You sure can, Brad, by using a technique that definitely will save you time. Begin by making a plywood pattern of each piece that requires tapered cuts. Then fasten the pattern to the stock with double-faced tape or screws. With a little planning, you may be able to position the pattern screws where you'll later make screw holes in the finished piece. Now, make a pattern-cutting jig by screwing together two pieces of plywood as shown on the drawing. Clamp the jig to your tablesaw's rip fence, and position its edge a scant 1/32" beyond the edge of the blade. Slide each pattern/stock assembly along the fence to duplicate the parts.

Filler sticks solve a burning problem

Q: No matter how careful I am, my projects sometimes have nicks that need to be filled. I've heard a little bit about a burn-in technique. How difficult is that skill to learn? Does it involve expensive equipment?

—Jerry Williams, Manchester, N.H.

An electric or manual burn-in knife enables you to make professional-quality repairs quickly. Buy a wide range of filler stick colors to ensure a close match.

A: The technique is easy to learn and gives excellent results, Jerry, although it's best used on finished surfaces where you can match the final color. You'll need a narrow, thin-blade knife similar to an artist's palette knife, a wax or lacquer filler stick that matches or is slightly darker than the surface you're repairing, and an alcohol lamp. Alcohol burns clean and won't overheat your burn-in knife.

Heat the blade of the burn-in knife over the alcohol flame until it's warm enough to melt a stick of the color you selected, but isn't so hot that it damages the surrounding finish. You can even scrape a bit from two different sticks to make an intermediate shade. Pass the blade through the flame again until the scrapings liquefy, and quickly smooth the material as you lay it into the dent. Allow about a minute of cooling time, then level the patch with a cabinet scraper or razor blade. A quick sanding with 220-grit paper, and you're ready to apply a touch-up finish, if desired. Woodworking catalogs offer a wide range of colors for the burn-in sticks, and clear for repairing a chipped transparent coating.

continued on page 102

Doors don't bind in a leveled cabinet

Q: I recently built a freestanding cabinet with carefully fitted doors and a base with legs. When I moved it from my shop to my living room, the doors bound. So I took it back to my shop to fix it, and the doors work fine. What's going on?

—David Marshall, Raleigh, N.C.

A: An uneven, out-of-level floor in your shop, your living room, or both may be causing your problem, David. Unless both locations are identical, the cabinet's frame can twist or rack when relocated to a new site. That can play havoc with tight tolerances in drawers and doors. To remedy things, carefully level your assembly table or workbench. Before your project leaves the shop, add adjustable feet to each leg or cabinet corner. That way, you can level the cabinet even if the floor is wavy or uneven. Use a padded leveling foot for hard flooring, such as wood or tile, and a smooth foot, like the one shown below, on carpeted surfaces.

Installing a leveler is as simple as screwing it into a pronged T-nut installed in each leg.

Got a question?

If you're looking for an answer to a woodworking question, write to **ASK WOOD, 1716 Locust St., GA-310, Des Moines, IA 50309-3023** or send us an e-mail at **askwood@mdp.com**. For immediate feedback from your fellow woodworkers, post your questions on one of our woodworking forums at **www.woodmagazine.com/forums**

what's ahead

Take a peek at what we're cooking up for the April/May issue (on sale March 22)

Projects for storing your stuff in style

FEATURED PROJECT

Outdoor bench with lift-up seat

Stash your deck, lawn, or garden gear in this weatherproof bench. It matches the Adirondack-style glider, settee, planter, chair, and footrest from earlier issues.

Ultimate garage/basement storage system

Adaptable and easy-to-build describe this versatile system. You can interchange its components in a number of ways to match your needs and space.

Chamfer plane

With this little tool you'll save the time and effort of putting a small chamfer bit into your router—simply pass the plane along an edge and finish the job in seconds. You'll have as much fun making it as using it.

Dresser-top valet

The next time you empty your pockets at the end of the day, keep items organized with this handsome project.

Tools, shops, and tips

TOOL TEST

Brad nailers reviewed

See how well 11 air nailers fired brads up to 2" long, and learn about today's new "micropinners."

Workshop Workover

Our intrepid workshop redoers work wonders on a Seattle garage that has lots of tools but little space.

Textured wood surfaces

With just a router or tablesaw and a few simple techniques, you can make panels with unique surface treatments.

Time-saving clamps

We tried 30 types of specialized clamps in the *WOOD*® shop—here are the five you'll find most useful.

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